THE

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TRUE AND FALSE ECONOMY.

THERE is in a man no surer sign of earnest purpose and whole-hearted diligence in the interests of his employers, than his perpetual dissatisfaction with existing methods, material or organisation. So far as his intentions are concerned, he is to be more highly prized by his superiors than the man who sees things as they are, accepts them as good enough, and never troubles to think of better.

But one zealous man can in his zeal do more positive harm to his cause than ever his lackadaisical brother, and here comes in the wisely repressive influence of the engineer if the man is a foreman, of the director or the committee-man if the man be the engineer, if it so happen that engineer or director or committee-man have the knowledge himself to say the zealot nay.

The self-educated foreman, the eager young engineer, fresh to power of spending money not his own, and fresher still to commerce, to the science which, when it sacrifices at all, gives up the smaller thing for the sake of a bigger, are both quick to learn and quick to make mistakes, and the chief fault in them is that they have not lived long enough to acquire a full sense of proportion.

The responsibility resting on these men may be great, but the responsibility which they provide for their superiors is still heavier, and their ultimate shape depends largely on the appreciation of this fact by their superiors. If the shape of the tongue, or the manner of the licking be not good, then the cubs cannot be expected to turn out fine, upstanding, bright-eyed fellows, knowing how to get the most honey out of the tree; but it will pay well if pains are taken over this same licking into shape, for upon the result may hang the difference between a dividend and a loss.

Once there was a foreman who "discovered" malleable iron. Thereafter he made good use of the discovery in places where previously no one had thought of using it, but he was not plentifully endowed with the sense of proportion, and he lost as much as he gained by putting malleable iron to uses for which it was never intended, and for which cheap cast-iron was good enough.

Then there was an engineer who used hardened steel trolley wheels because he got only 5,000 miles out of the usual gun-metal wheel; and there were quite a number of tramways on which the brake blocks were chilled so that they might last longer.

Instances of a similar wall-eyed way of looking at things will occur to most of our readers. Those we have given will serve to illustrate the meaning of our opening remarks.

There is, however, wide room for judicious economy of material in tramway construction and maintenance, and we are glad to think that the knowledge of this is soaking gradually into the minds of tramway men. We seem to have taken expensive ideas from the Americans during the

renaissance of tramways, and we have been ten years getting rid of them.

Gun-metal, or what went by that name, was to be seen bespangling every part of a new tramway. Trolley heads, controller-handles, hangers, everything that could be cast was made of gun-metal; but the fact that cast-iron, malleable iron, and steel can be used to as good purpose for many of the articles which figure in a catalogue of tramway supplies is becoming more widely known, and we hope to find that the manufacturers who are exhibiting at the Agricultural Hall next week have not been slow to appreciate it.

To exemplify the above statement, we open, at random, a catalogue of overhead material, and find "straight line hangers without insulating bolt" listed at 2s. 9d. each in bronze, and 1s. 3d. each in malleable iron. On that little item alone a saving equivalent to the interest on £200 capital can be made on every mile of tramway. Then the price of trolley-heads may be reduced by two-thirds, by exchanging gun-metal for malleable iron, and much of the gun-metal work in trolley-wire ears and other fittings may be made just as well of a cheaper material.

Although much has been done already in the direction of cheapening materials, very much remains to be done, and we look to the engineers and the foremen to take advantage of experience, which has been bought elsewhere and need not be paid for again, and to keep ever on the alert for new economical openings.

The L.G.B. and Suction Gas Producers.

In the current issue of the *Local Government Journal* there is a letter by Mr. D. Herbert Grimsdale in reference to an inquiry by the Local Government Board's Inspector into an application by the Uxbridge U.D.C. for a loan for a power plant of 40 H.P. There is already installed a Dowson producer gas plant, which is to remain as a duplicate, and the inclination was in the direction of installing another gas plant rather than having both steam and gas plant in the same works, so, as an alternative to steam, suction gas plant was suggested. However, according to Mr. Grimsdale, the Inspector stated that the L.G.B. considered the suction system to be in the experimental stage, and would not sanction a loan for such a plant.

Though still in its infancy in point of years, the appreciation which it is meeting from all classes of power users, public and private, speaks volumes for the new system. It would be impossible to estimate the number of suction gas plants in existence, as so many have been installed by private firms, but the fact that there are nearly 40 different types now on the market will give some idea of what manufacturers think on the matter.

Though the pressure producer had become so far established as to meet with the approval of the L.G.B. as being past the experimental stage, the improved economy, lower first cost and other advantages of the new system have so affected the rival pressure system, as to cause it to adopt the regenerative method of raising the steam in place of the older arrangement, which included a steam boiler, thus effecting an economy of fuel amounting to something like like 12 per cent. of the fuel gasified in the producer.

That there may have been some special circumstance in connection with the Uxbridge application is indicated by a letter from Mr. Hugh Campbell in the *Engineer*, June 23rd, 1905, in which he quotes an instance where the L.G.B. *has* granted a loan for the specific purpose of installing suction plant—namely, that of the Chippenham U.D.C. for a pumping installation, consisting of two 40-B.H.P. and one 25-B.H.P. gas engines, with suction plants—and says that his firm has several other orders in hand for similar contracts. The same firm has put down the following plants for similar duty to that required by the Uxbridge Council:—One 60-B.H.P. gas engine and suction plant with treble ram pump for Combe Down Waterworks; and four gas engines and suction plants driving sewage pumps for Kingswinford U.D.C., Worcestershire.

Mr. Campbell goes on to point out "that while it is true that the suction plant has not been offered freely here until about two years ago, it has been in regular use on the Continent for several years past, and in view of the successful results obtained, it is difficult to understand the attitude of the Inspector recorded by Mr. Grimsdale.

The International Glow Lamp Syndicate.

The Vienna Court of second instance, which recently affirmed the decision of the lower Court dismissing the action brought by the firm of Watt against the International Glow Lamp Syndicate, took the opportunity of discussing the question as to whether agreements such as existed between the contending parties were valid for Austria. It was found that syndicate agreements which actually fall within the scope of Sec. 4 of the Austrian Coalition Law, and also if they have to be judged according to German law, can have no effect in Austria. But the Court came simultaneously to the conclusion that Sec. 4 of the Act could not be applied to the case of Watt *versus* the syndicate. The regulations made under this particular section refer to rings formed between producers and merchants, not for the purpose of regulating the output, but with the object of increasing the prices of goods to the detriment of the public, and thereby securing to the parties to the agreement a profit which cannot be justified from the standpoint of sound national economy. In finding that the section could not apply to the action in question, the Court considered that it was sufficiently proved that the glow lamp market, prior to the constitution of the syndicate, was entirely disorganised, and that conditions existed which could not be of long duration. The individual members were compelled to agree to deliver lamps only of good and uniform quality and corresponding to the present state of technical manufacture, and special rules were adopted to secure the fulfilment of this part of the syndicate agreement. It was further provided that patents and inventions representing improvements should be placed at the disposal of all the members, and a technical committee was to be appointed. An inspection of the correspondence which preceded the conclusion of the syndicate agreement left no impression that these regulations were not seriously intended, even if an increase in prices was hoped for as a result of the formation of the ring. Thus the results of the arrangement, the Court concluded, afforded no justification for subjecting the syndicate to the operation of Sec. 4 of the Coalition Act. It will be seen from this judgement that the question whether syndicate agreements between German and Austrian undertakings are valid mainly depends upon the problem as to whether the ring inaugurates a price policy of exploiting the public; but difficulties naturally arise as to determining where such a policy begins and where it ceases.

Electric Tramway and Railway Table.

Our annual list of Electric Tramways and Railways of the United Kingdom is issued as a supplement to this number of the Electrical Review, and on the same sheet is given a list of Power Distribution Companies at work or projected. We wish to acknowledge our indebtedness to the numerous engineers, secretaries and others, whose kindly aid alone enables us to compile these tables.

The second part of our list of Electricity Works will be issued early in July.

RYMER-JONES'S STANDARD CONDENSER.

THE tinfoil and mica condenser ordinarily employed as a *standard* wherewith to compare other unknown electrostatic capacities cannot be absolutely depended upon to remain perfectly constant, but requires itself to be re-standardised from time to time. For, although those made by the best makers are often remarkably constant, this fact is not a sufficient guarantee that any particular standard has remained absolutely correct, and owing to the very stringent conditions enforced as to capacity, and the possibility of cable being rejected should it not exactly conform to the specification value, the reliability of the standard condenser employed is a matter of paramount importance.

Among possible causes of change are varying pressure between plates, flaws or cracks in the mica, air bubbles, and, perhaps worst of all, moisture, which in damp and hot climates is liable to find its way in, and is readily absorbed by the paraffin wax.

The usual method of constructing a tinfoil and mica condenser probably contributes to varying pressure between the condenser plates. It is as follows :—

Tinfoil and mica sheets are alternately laid over each other in a "form" with hot paraffin wax between them—the foil being smoothed over to remove creases and exclude air bubbles as each is added—until the requisite number for a given capacity has thus been built up.

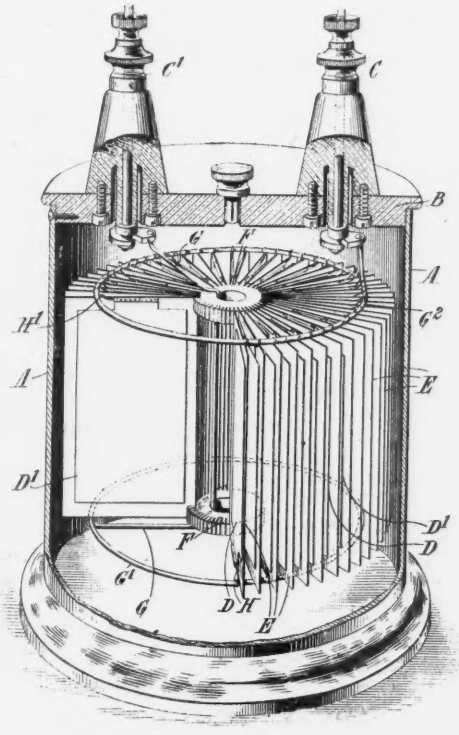

FIG. 1.—SECTION OF CONDENSER.

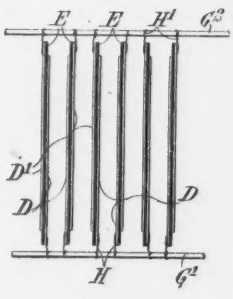

FIG. 2.

The compacted mass is then transferred to a press and subjected to considerable pressure, which consolidates them still further and expresses superfluous wax; the exact resulting capacity depending on the degree of compression, which compression to some extent depends on the temperature of the mass. A lug on each tinfoil projects beyond the mica; the lugs of the first, third, fifth, &c., foils being on one side, and those of foils two, four, six, &c., on the other side of the condenser. The lugs of the uneven numbers are soldered together, and those of the even numbers similarly connected. These condensers are afterwards embedded in paraffin wax and clamped between metal brass plates firmly screwed together, and the whole is finally laid in its case, and the space around it also filled with wax.

As thus constructed, each foil when charged acts inductively through the mica sheet *on both sides* of it.

It is evident that, since the films of paraffin wax soften as temperature increases, and the whole mass expands between its metal frame plates, the effect is to further compress these films and bring the foils closer to the mica, and thus increase the capacity and decrease the dielectric resistance. A marked fall of temperature, on the other hand, contracts the block in some degree, and renders the paraffin more solid; and owing to this fact, and to the plastic nature of the paraffin, this fall of temperature cannot restore to its original thickness the paraffin wax already compressed by the previous expansion under heat. Moreover, the expansion and contraction under varying temperatures of the metal plates between which the block is tightly confined, doubtless also play some *rôle* in the small changes of pressure constantly going on inside the condenser. Whatever, however, may be the precise nature and effect of temperature variations, it is reasonable to expect that in course of time they will produce some change in the capacity of the condenser, considering how thin is the dielectric between foils, and the importance, therefore, of any change in their distance apart, however slight.

Clearly the essential requirement of a portable standard condenser for practical use is that its capacity, when once standardised, shall remain constant, or at least vary only in such a regular and known degree under changes of temperature that a correction may be applied by a table of coefficients suitable to the condenser.

Instead of building a series of alternate foils and mica sheets into a block, as already explained, and subjecting it to pressure, the writer constructs his standard condenser of a number of independent elements, as in fig. 1, each of which contributes its individual capacity to the total value, but has no inductive effect on its neighbour placed on either side of it.

Each element is formed by a mica sheet E, with a foil D, D^1 on each side, made to adhere firmly to the mica by an adhesive film of shellac. A large number of these are for the sake of compactness arranged in a circle around a central slotted ebonite ring F, placed at each end of the mica sheets, into which slots the innermost edges of the mica sheets are laid to keep them at regular distances apart, like the spokes of a wheel. The tinfoil attached to one side of a mica sheet has a lug projecting at the one end, while the lug of the foil on the reverse side projects beyond the other end of the mica. These two foils and the intervening mica sheet thus form one element. The tinfoils of the element next to it in the circle, in both directions, have their lugs projecting in the reverse direction. This arrangement of lugs enables the foils to be conveniently connected up as required. The method of connecting up will be more readily understood by reference to the diagram, fig. 2, showing how all the pairs of foils D on one side of the condenser are attached to a stout circular wire G^1 by means of the fine wire H soldered to every lug on the one side, while a similar circular wire G^2 electrically connects together all the pairs of tinfoil D^1 having their lugs on the opposite side of the condenser wheel. It should be understood that the right-hand foil of one element and the left-hand foil of the next element, which are separated by the intervening air space, form one of the *pairs* of foils referred to, and these being connected together electrically, in the manner described, the air space clearly influences in no degree the capacity taken up by the elements; the induction only taking effect through the mica. Thus the relative distance of the elements from one another does not affect their capacity, and any change can only take place in the individual elements themselves.

The circular wires assist in holding the wheel together, and prevent the mica sheets from withdrawing themselves from the slots in the central ebonite ring, into which their inner edges are fixed by shellac varnish. They, moreover, form the two sides of the condenser, and are connected to the lower extremities of their respective terminals C, C^1 on the cover of the case A containing them by means of short and stout but flexible wires G, which hold this light condenser in mid-air, and thus insulate it perfectly from the box. The only leakage, therefore, possible, is over the lacquered surface of the

mica sheets of the condenser and the ebonite pillar terminals.

This method of joining up the several elements forming the condenser requires twice the number of tinfoils usually employed, but only the same number of mica plates. The important advantage secured is that induction takes place in one direction only, viz., through the mica, so that each element is unaffected by any change in the position of the adjacent elements.

Paraffin wax, with its attendant disadvantages, already referred to, is done away with, and varying lateral pressure due to expansion and contraction from change of temperature does not exist. The only way in which temperature can bring about a change in the capacity is by its direct influence on each single element.

Provided that all air bubbles are excluded when the tinfoil is attached by adhesive lacquer to the mica, any change is limited to the film of dry shellac and to the superficial expansion and contraction of the foil by temperature. When the former has become thoroughly hard, the condenser is subjected to widely different temperatures, and the relative capacities at these and intermediate temperatures are measured to form a coefficient table from which to reduce the known standardised value at any given temperature to its true value at any other temperature obtaining when used for testing.

Condensers thus constructed have been subjected to temperatures as high as 140° F. without being detrimentally affected.

Some of these condensers have been under experiment for many months, and they have given regular and satisfactory results, which I propose to publish when the tests have been sufficiently protracted to prove their constancy.

As the surface of the condenser is large and the plates very thin, they very soon take up the temperature of their case, which has a plugged hole in its cover for the introduction of a thermometer. The case is rendered dust and damp proof, but the suspended condenser can easily be taken out and warmed in front of the fire in the event of the measured D.R. showing surface leakage.

Should any one of the elements suffer damage, its fine wire has only to be unsoldered from the two stout wire rings referred to in order to replace it by a new one. J. R. J.

THE STARTING OF INDUCTION MOTORS.

By FRANK LEWIS.

If it is required that an induction motor shall start under load without drawing a greatly larger amount of current than that absorbed when running at full load, the rotor windings must have a certain resistance, as otherwise the rotor and stator currents are not at 180° phase difference to one another; but there is a considerable lag of the rotor currents.

In order to insert such resistance the method adopted as a rule consists in having a three-phase rotor-winding, either star or mesh connected the ends of which are brought out to rings on which brushes bear, and to the latter a three-armed resistance switch is joined, so that a resistance connects together the leads, which can be cut out gradually, until finally when running the three brushes are short-circuited. It is often arranged that when running the brushes can be lifted and the rotor windings short-circuited by actuating a switch which is fixed on the rotor itself. This prevents the wearing of the brushes and rings, except at starting.

If a motor is required for such purposes as running a line of shafting where it is not necessary to start under load, the squirrel cage rotor is greatly preferable, as rings and brushes, especially in dirty situations such as shipyards, are liable to break down.

The squirrel cage induction motor is started by impressing a lower voltage on the stator by means of an auto-transformer. For such a motor up to 10 H.P. one step is all that is generally required, but for larger ones more steps will be needed; for instance, should the motor be employed on a 200-volt circuit, whilst starting voltages of 100, 150 and 175 volts may be used successively. For crane motors, short-circuited rotors are often used, but the rotor winding is of such resistance that it has a 25 per cent. slip at full load. In order to alter the speed of the motor at will, the auto-transformer method is employed. For such purposes this type of motor is suitable, as the motor for but short periods requires to run at full speed, so that the efficiency under actual conditions is nearly as high as in a machine where the rotor at full speed is of low resistance. Besides this, for crane work, the extra leads required from the motors, and also the absence of simplicity of the machine itself, make slip-rings and brushes undesirable.

Various designers have, from time to time, attempted to design induction motors in which the rotor has resistance in circuit at starting that is subsequently cut out, but in which slip-rings are eliminated. Mr. C. E. L. Brown has designed a machine in which the resistance is carried on the rotor, and a lever is arranged on the shaft to enable the operator to actuate contacts to short-circuit it when the machine acquires speed.

Steinmetz has designed a machine with a high resistance squirrel-cage winding and a low resistance distributed winding on the rotor: at starting the distributed winding is open-circuited, and the motor starts therefore on the squirrel-cage winding only; when running, the distributed winding is connected up in a similar manner to the Brown machine.

There have also been machines made by various firms in which the resistance in circuit with the rotor is short-circuited by means of an apparatus operated by centrifugal force when the motor reaches a prearranged speed. All these types demand a complicated rotor.

To another catagory belongs what the writer terms the "selective winding" method of starting.

The first machine of this type was designed by Bradley, and consists of two entirely separate squirrel-cage rotors of the same length on one shaft, one of high and one of low resistance, and a single stator which can be made to traverse so as to embrace either rotor. At starting the stator embraces the high resistance rotor, and as the motor acquires speed, it is traversed gradually to embrace the other one. A later patent of Bradley's describes a motor with two stators and two rotors. The former have separate windings, and the latter have a squirrel-cage winding in which straight

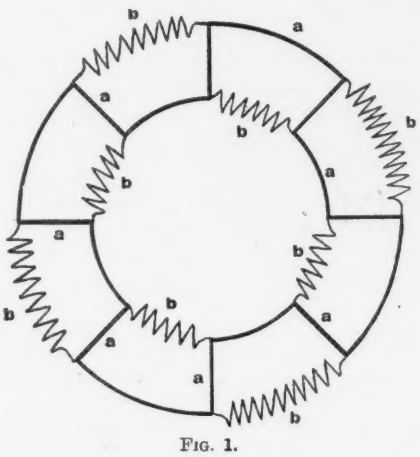

Fig. 1.

conductors pass from one rotor to the other, the rings of the ordinary squirrel-cage winding being at the outer side of each rotor. Between the two rotors a high-resistance ring connects all the conductors. If the angular positions of the poles and phases on each stator are the same, the currents pass from one rotor to the other, and the machine operates as if there were but a single stator and rotor. To start the motor, means are provided to keep the angular positions of the poles the same, but to alter their phases with regard to one another by 180°. This can easily be done by reversing the current in each phase of one stator. The voltages in each conductor will now be in opposite directions in each rotor, so that the currents take the path through the high resistance ring in the centre.

Both these machines of Bradley's have the insuperable objection of requiring a long shaft, a great disadvantage with induction motors, which must for reasons of efficiency and power factor have small clearances. The first of Bradley's machines has not, in the writer's opinion, strictly speaking, a selective winding, but the second machine has one. A selective winding consists of a method of selecting a high or low resistance rotor winding by a change in the stator connections. The advantage of this consists in its obviating sliding contacts on the rotor.

The next motors with selective windings were evolved by Deri. He provided a rotor winding as shown in fig. 1. In the figure, only one conductor is shown, but there would be, of course, a number of other similar ones in practice; *a* represents the low-resistance conductor, the ends of which are joined together; and *b* consists of high-resistance connecting pieces. There is the same number of poles on the rotor winding as on the stator. At starting, the number of poles on the stator on each phase is halved by means of a change in the connections. This change has the effect of making the voltages on all the conductors of each of the rotor windings, when added together, produce no pressure, taking the sign and phase into consideration. The current, however, has a path through the high resistance connections, and each winding is virtually a squirrel cage one, with only two conductors per pole.

At full speed, when the machine has the ordinary number of poles, the motor works in the ordinary manner, only a small current passing through the high resistance connections.

The objection to this machine is that the best theoretically possible result at starting would be twice full load current for full load torque, as by halving the poles the full speed of

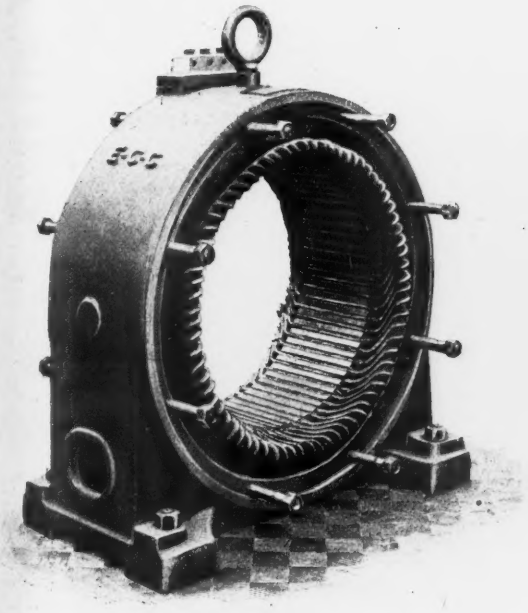

Fig. 2. Stator and Rotor of Lewis Induction Motor.

Fig. 3.

the machine, if there were no resistance in the rotor, would be doubled, and the best possible result is that starting torque for full load current, which would give the rated horse-power of the machine at double its ordinary speed. In order to obviate this, Deri took out a later patent in which, instead of halving the poles on the stator at starting, he changed the number of poles, say, from 8 to 6, 10 to 8, &c., a change which, as can be seen, from a mathematical standpoint, produces selection. Another easy way of seeing that the voltages oppose is to draw equal lines representing the E.M.F. and phase of each conductor of one winding, in the form of a clock diagram. The rotor was similar to his former one, the distributed winding on the rotor having the same number of poles as the stator. The path of the current at starting is through the high resistance connectors, the slight difference in pitch between the starting number of poles and the rotor poles being too small to matter. The objection to this machine is that, except with a ring-wound stator, which is not a good or practical type, the stator change from eight to six poles demands a too complicated switchgear. The small difference between the number of poles for starting and running practically overcomes the objection to the first Deri machine.*

The writer has designed a selective winding which does not require a complicated switchgear, and which fulfils the necessary conditions for efficient selection, these consisting in having as little difference as possible between the angular speeds of the rotating field of the stator when running or starting. For this type take, for example, an eight-pole machine. If with a direct current passed through the winding of one phase the polarity at running were N.S.N.S.N.S.N.S., then at starting the connections would be changed to make the polarity N.S.N.S.S.N.S.N. The voltages on a wave-wound rotor, when each phase of the stator is fed with current with the connections as described, will now obviously oppose one another.

Above the wave winding a high resistance squirrel-cage winding is provided. This is preferable to having high resistance pieces connecting the low resistance wave winding, as a squirrel-cage winding will dissipate the heat better, owing to its offering a larger surface, and not being covered by end connections. The machine at starting will be exactly the same as if two portions of the stator at the two opposite points where the current is reversed were not wound; the extent of the portion unwound is the pitch of one pole at each point of opposition.

The angular velocity of the rotating field is the same whether the stator is connected for starting or for running. As two poles are always in this type of machine neutralised, and as these two poles are a source of magnetic leakage which lowers the power factor and therefore the starting torque, the greater the number of poles the less is this leakage in proportion.

In order to make this leakage as small as possible, the type of stator shown in the illustration, fig. 2, should be used, as with the ordinary Continental type, a small leakage pole is produced. With this type of selective winding, full-load torque should be obtained with $1\frac{1}{3}$ full load current for a ten-pole machine, which compares favourably with a slip-ring machine, if you take that position of the rotor which gives minimum torque.

With slip-ring machines, as the rotor slots must be a number which is a multiple of six, it is impossible to make a machine, particularly for three-phase currents, in which

* Deri, in his specifications, also describes the application of his selective method to single-phase machines which start as repulsion commutator motors, and run as induction motors.

the magnetic circuit is not better with the rotor in certain positions, hence the difference in starting torque. It is the minimum torque which should be compared, in the writer's opinion.

In conclusion, the writer would like to take this opportunity of acknowledging the great help given him in perfecting this machine by Mr. Buchanan, of Wolverhampton.

CAR-WHEELS.

From a paper which recently appeared in the *Street Railway Journal*, we gather that experience on the Hartford (U.S.A.) Street Railway system is favourable to steel tires, even on city routes, where hitherto the cast-iron wheel has held its own, and this is said to be so on a basis of relative cost. Part of the Hartford lines is interurban, cars running 200 miles a day on a 14 miles stretch, so that the speeds are on a railway level; while part is urban tramway. As we might expect, the mileage made by wheels on the interurban track is high, but we cannot use interurban figures as arguments in the case with which we are most interested, as the conditions of urban traffic are so much harsher.

Steel tires *must* be used where speeds are high and loads heavy. Further accidents do not arise from broken wheels on slow-speed English tramways, but a disaster might follow such a mishap when speeds run high on sleeper track. No economy in material is justified morally, and luckily is seldom justified commercially, where human life and limb is set against the cheaper material.

The Hartford experience starts from 1900. Up to the date of the paper none of the tires on the 14 cars equipped in October of that year had been removed, so that an estimate of full life deduced from mileage to date has to be made if a true comparison with another type of wheel is to be made.

This figure is taken at 200,000 miles, although none of the urban wheels have turned half that distance. For some reason which is not given, the wheels on five cars equipped in October, 1900, and used in the town on 4-ft. wheel base bogies, averaged 74,000 miles to date, while wheels under 11 cars furnished just 12 months later, and used under the same conditions, averaged 89,500.

No particulars of track construction on the town routes are given, but it is probable that the step rail so much used in America is used in Hartford. In that case the average of "not over 30,000 miles" for chilled wheels is peculiarly low, and the writer of the paper under review complains of flange troubles due to uncertainty in manufacture, unequal heating of the periphery from heavy braking, and worn special work. These troubles have been encountered to such a degree that cast-iron wheels are renewed every year, as they cannot be depended on for a second season. These troubles must have been accentuated by the use of bogie trucks with a wheel base less than the gauge of the track. The Master Car-builders recognised long ago that the wheel-base must be greater than the gauge, and we can understand that the same grinding effect which wears the flanges of the tires thin on the diagonal wheels of the Hartford trucks, and so calls for more frequent turning than would be required otherwise, has done no good to the flanges of the chilled wheels, and has helped to bring about that unreliability which has resulted in an automatic closure being applied annually to their useful lives.

Under happier conditions the cast-iron wheel would have led a pleasanter and longer life, but there does not seem to be much doubt that in this particular case the adoption of steel tires is an alternative preferable to buying new trucks with wheel-base suited to the gauge, to renewing the badly worn points and crossings, and to equipping every car with some form of track or electric brake.

As we have said before, the problem, "Which Wheel?" must be worked out by every man for himself, for, although what is poison to the cast-iron wheel, is by no means good meat to the steel-tired wheel, the former may be killed suddenly by the bane which will take off the latter in a lingering fashion, which is economical by comparison.

We are glad to have further details of comparative cost as they have been found at Hartford. Steel wheels are to cast-iron wheels as 4 to 10 when a single cast-iron wheel is compared with a steel tire only, and without allowing for the scrap value of either. We cannot agree that the prime cost of the steel-tired wheel should be left out of the equation, although it is permissible to count the centres in the capital cost of the trucks.

The American writer states the prime costs as follows:—

Cast-iron wheel	£1 to £1 9s.
Steel tire only	£2 10s.
Steel wheel complete	£6 10s. to £8 10.

from which we deduce the prime cost of a set of centres for one truck to be £18 to £26, which is a heavy percentage of the prime cost of a truck without wheels.

When the cast-iron wheels and the steel tires are counted in the prime cost, as, of course, they would be at the outset, the extra for steel tires per truck comes to £24 to £30. If a truck with chilled wheels costs £60, the cost of the same truck with steel wheels will be, therefore, from 40 per cent. to 50 per cent. greater.

Since we warned tramway managers against replacing cast-iron wheels with steel-tired wheels with a diameter of 30 in. to 31 in., we have heard of more than one instance of that very thing being done with most unsatisfactory results. Naturally enough, it is impossible to get anything like the full life out of them, and the result must be that the cost per 1,000 miles is excessive.

On one tramway the cast-iron pony wheels of maximum traction trucks became flatted incurably, although the brake was not applied to them. The manager happened to be smitten with the steel tire disease, and changed all the cast-iron pony wheels for tired wheels of the same size. The only result was that the flats were distributed more evenly over the tread, and investigation of the cause of this most peculiar phenomenon of flats without brakes showed that it was outside the wheels altogether.

To those buying cars for urban service, our advice is to specify cast-iron wheels of not less than 31½ in. diameter, and 33 in. if possible. In that way the heavy extra capital cost of steel-tired wheels is avoided, while leaving the way clear for obtaining the best results from them, if it is considered economical or desirable to install them later.

AN AUSTRALIAN STATION HAVING COMPOUND-WOUND DYNAMOS PARALLELED WITH ACCUMULATORS.

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

The writer recently had an opportunity of visiting the Empire Electric Lighting Station at Sydney. This station has been running for some eight years, and is supplying electricity to private customers in the northern half of the city. The building is in two stories, the lower containing the engine and boiler rooms, and the upper having various offices, stores, test room, accumulator room, and a workshop. The chimney stack is 110 ft. high with an internal area of 25 sq. ft., and is lined with firebrick for 50 ft. up.

The boiler room contains four Babcock & Wilcox boilers, each having an evaporative capacity of 4,200 lb. of water per hour with a heating surface of 1,620 sq. ft. They are each fitted with chain grate automatic stokers, and the coal used is a cheap slack, costing about 7s. per ton. The coal is a mixture of hard and soft qualities from the Lithgow district in the Blue Mountains, and it burns practically smokelessly. Mr. Gardam, the managing engineer, hit upon it after a considerable amount of experimenting. A considerable quantity of soft coal from the Newcastle and Bulli districts is burned in and around Sydney, and, as there is no regulation against the making of smoke, there are many smoky chimneys.

The boilers are also fitted with superheaters of 200 sq. ft. heating surface, the tubes being bent U-shape, and connected at both ends with manifolds, one of which receives

the steam from the boiler, and the other collects the superheated steam and delivers it to the valves. The degree of superheat ranges from 100° to 150° above the temperature of steam at the working pressure of 125 lb. per square inch, and can be varied by the admission of saturated steam from the boiler by a by-pass into the superheated steam. The feed to the boiler is supplied by electrically-driven three-throw pumps, which force the water either through the feed-water heater, or direct into the boilers, and take it from the town supply or from the reserve tanks.

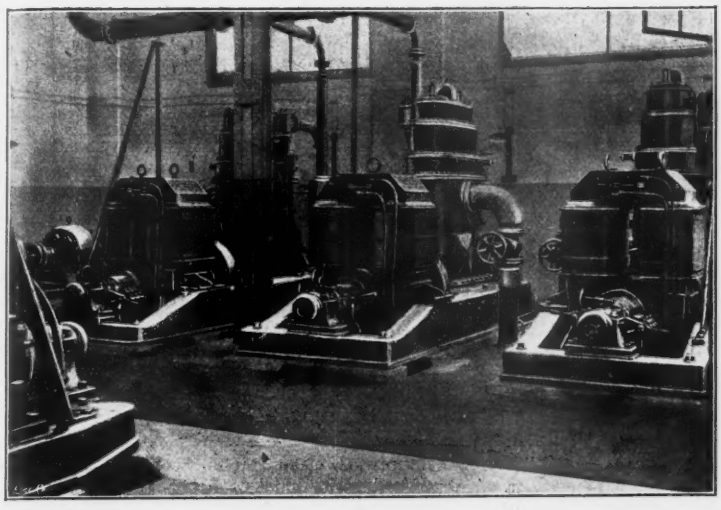

Fig. 1.—Engine Room of the Empire Electric Lighting Station, Sydney.

In the engine room (fig. 1) there are five Alley-MacLellan engines of the tandem-compound, non-condensing, single-acting, high-speed type, driving 220-volt generators of Parker's well-known make, the armatures being wound on the Eickemeyer principle. They are arranged in such a manner, that by re-connecting the armatures double the pressure can be obtained from the machines.

The switchboard (fig. 2) consists of eight panels of white marble bolted to an angle iron framework; five of these panels are devoted to the generators, one is for the battery, another for the feeders, and one for the works lighting and motors.

In the accumulator room there are 115 cells made by the Tudor Co., of 1,000 ampere-hours capacity. They are principally used to assist in the economical working of the station by helping the plant at its heaviest loads, and are recharged during hours of light load in the morning. The excess of voltage required above the bus-bar pressure is provided by a Westinghouse motor-generator set.

An interesting feature of the station is that although all the machines are compound-wound—indeed, they are over-compounded 5 per cent.—they are run in parallel with the accumulator battery. Readers will remember that practically all text-books state that it is necessary to use shunt-wound dynamos when working with accumulators. Yet here is a station which has for many years been doing most successfully that which was supposed to be impracticable. The regulation of the station is the most perfect the writer has ever seen, and the manager claims that it does not vary more than 1 per cent. in a year. The reason is, of course, that on account of the over-compounding of the dynamos the voltage is automatically regulated to suit the load.*

The accompanying diagram, fig. 3 (p. 1048) shows the arrangement of the connections, and it will be seen that one of the main switches for each machine is of the I.T.E. circuit-breaker type. This circuit-breaker is fitted with a special differentially wound coil by means of which it is tripped in case of a reverse current from the cells or from any other machine.

In order to ensure that each dynamo shall take its fair share of the load, it is important that the resistances of the series coils shall be relatively proportioned for their respective outputs, and as this resistance is very low, special attention has to be paid to the section of the equalising cables. When, however, these are once adjusted, they require no further attention.

When switching out a dynamo, the practice at this station is to insert shunt resistance until the machine only gives a small current, when the main switches are opened with very slight arcing. By this method there is absolutely no blink in the lights, the machines which still remain in circuit taking up the additional load automatically, and by reason of the over-compounding adjusting their voltage to suit the load.

It is well to point out that, on account of the series turns, the commutators work practically sparklessly and with very little movement of the brushes. This is, of course, largely due to the fact that the series turns increase the field magnetisation in the air-gap just at the time when such increase is most required for sparkless commutation.

The number of lamps now connected is over 36,000 in 8-c.p. equivalents, and the rates charged are:—For lighting, 4½d. flat rate, or 5d. and 2d. maximum demand rate. The price for power is 2d. per unit, and the station has a growing motor load. This is very satisfactory when one con-

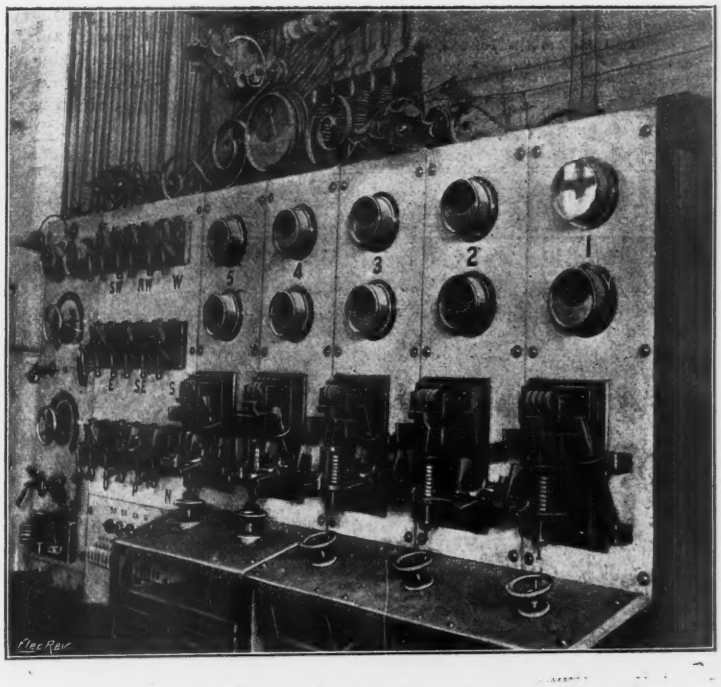

Fig. 2.—Main Switchboard.

* It has always been a surprising thing to the writer that designers of English stations should so slavishly follow each other and install the ordinary shunt-wound machines, and he remarked on this some years ago in one of the technical papers.

siders that in 1897 the station started with only one 25-H.P. dynamo.

Another interesting feature of the plant is that all the mains are overhead, and Mr. Gardam says that he has had such uniform success with them, that if he were laying down a new station he would certainly adopt such overhead lines where convenient. Each of the feeders is protected by lightning arresters, these being of the Garton-Daniel type with choke coils. At a certain period of the year lightning storms are pretty frequent, but no discharge has ever entered the station.

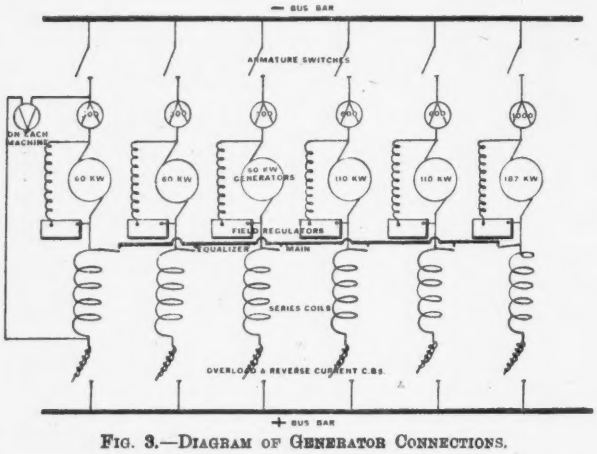

FIG. 3.—DIAGRAM OF GENERATOR CONNECTIONS.

Of course, in respect of the overhead mains, it is not claimed that the installation is up-to-date, otherwise the mains would all be placed underground; but, considering the unsatisfactory position of the company in regard to their legal right to take up the streets, undergrounding was out of the question.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Gas v. Steam.

A 60-KW. dynamo direct-coupled to a 100-B.H.P. gas engine driven by a suction gas producer would generate electricity at a cost of ·172d. per unit, running full load for 50 hours per week. Taking a load factor of ·6 the cost would be ·25d. per unit. These figures are obtained after charging for fuel at 22s. per ton, labour at 30s. per week, and interest and depreciation on a capital outlay of £1,200 at 10 per cent—not that this sum is required to keep up the plant, but because it is a figure that allows one to march with the times.

As regards the cost of oil, stores and water, it is difficult to give any figure—depending on how you obtain your water, who orders the oil, how many cats you have—it may vary from ·1d. to ·2d. per unit, but should not exceed the latter.

It would be absurd to put down gas-driven sets without a producer; the cost of the producer will not add 15 per cent. to the cost of engine and dynamo, and will save 80 per cent. of the gas bill with town's gas at 2s. per 1,000 cb. ft., sufficient in a plant of this size running at full load to pay for the whole plant—engine, dynamo and producer—in less than four years.

With this class of producer the labour is small, stoking at the outside every two hours, the stand-by losses are practically nil, and the engine can be driven economically at quarter load or no load.

A. Egerton Hall.

Hyde, *June 26th*, 1905.

The opinions of men-in-charge are always worth attention, not only because more can be learnt from experiencing trouble than by the ordinary successful working of gas engines and similar motors, but also because such opinions show in which direction it is necessary to educate these worthy persons. Upon the education of attendants the future of gas engines depends, as, if "trouble, unreliability and uncertainty of action" occur beyond the power of the attendant to put them right, the universal application of the internal combustion engine, which we all desire on account of its proved economy, will be deferred. "Scrapping" will not be the result, as it must be obvious to all that if a gas engine will run all right for two or three hours it is proof that the engine, as an engine, is correct, but that some change of conditions has occurred which baffles the man-in-charge to diagnose and remedy it.

Your correspondent, "Magneto," evidently merely wants putting on the right road where his energy, zeal and capacity will have a chance to "get right there." He has hitherto missed the turning through lack of signposts.

He should think, first of all, of the necessary conditions to ensure good starting:—Removal of air from connecting pipes, adequate provision of gas at slight pressure, proper proportional admixture of gas and air, tight valves holding against compression, clean internal parts with piston free from gummy deposit, efficient firing device, compression relief device, air only, (no unburnt gases) behind the piston when starting, piston being slightly forward on charging stroke.

The limits of a letter render it impossible to deal with all possible causes of starting failures, but, with careful supervision of all these points before a start is essayed, a successful getting to work is certain. Should, however, the engine fail to start, to how many attendants does it occur to expel the unexploded charge that missfired before re-commencing operations?

Over and over again has the present writer had to speak to men-in-charge about this very point, and evidently "Magneto" has had similar experience with the engines under his care. He says "until the critical moment has passed, &c." This is probably entirely parallel with the experience of a motoring friend. He had driven in his car to his office, and afterwards had very little time to spare in which to get to the station on his way to town. Three unsuccessful attempts to start the engine were made. My friend knows his car and engine thoroughly, and looked over the mechanism, failing to find any defect when the engine was pulled round by hand with the petrol shut off. Finding nothing, he was puzzled, and commenced to fume. Time was running short, and he tried again to start in the usual way, when, much to his surprise, it went off beautifully. He spoke of the unexplainable moods of his engine, just as "Magneto" does, but what is more simple than the explanation that, after the first failure, succeeding efforts rendered starting more and more improbable, owing to the cylinder being full of mixture too rich to burn. Only after the rich mixture has become diluted or has been expelled is it possible for normal conditions to be obtained and a proper start effected.

But "Magneto" mentions also that artillery practice would commence after the engine had been at work for two or three hours. When the makers replied to him in the way he so much resents, they were undoubtedly right in refusing to consider the engine at fault when it would run for two or three hours correctly and then begin to fail. What does the artillery practice denote? Most frequently it is caused by defective ignition, such as a "cool" tube. The calorific value of the gas would not matter much if it varied within certain limits, but if the *pressure* of gas were varied then trouble would occur, either if the gas were too much in excess owing to increased pressure, or if it were deficient owing to decreased pressure. Space does not permit more detailed instructions in this column, but perhaps sufficient has been said to put "Magneto" on the right road, and he will himself be able to follow the trail which will lead him on to consider the ill-effects of particles of glowing carbon in the combustion chamber or behind the piston, and what would be likely to happen if the mixture were still alight throughout the exhaust stroke and set fire to the incoming fresh charge of the following cycle, and also what

happens if the ignition of one charge entirely fails and leaves the combustion space full of mixture enriching the succeeding charge. If he arrives thus far he will be able to look back over his experience and realise how troubles may be caused, and as a necessary consequence he will then see how to prevent their occurrence.

William A. Tookey.

Westminster, *June 27th*, 1905.

Indication of Leakage and the Home Office Rules.

Mr. Vignoles, in his letter in your current issue, maintains that the instrument which the Regulations say is to "show immediately any defect in the insulation of the system" should give a "continuous indication of the insulation of both mains." We certainly cannot find any indication in the rules themselves of any such intention, but we quite agree with Mr. Vignoles that "the point is not worth pursuing," though we cannot help wondering in that case why he cried "Wolf!" at all.

The point, however, which we wish to emphasise refers to the rule which lays down that a daily record of the leakage current from main to main is to be kept in a book. Now, according to Mr. Vignoles, this leakage current can "only be derived somewhat laboriously from a measurement of the insulations of both mains and a calculation." Of course, the term "laborious" is somewhat vague, but we shall be quite prepared to own ourselves entirely in the wrong if Mr. Vignoles can produce anyone over the age of 10 who is unable within the space of three minutes, with one of our direct-current two-wire leakage indicators, to measure and "record" not only the leakage current, but also the separate insulation resistances of the positive and negative mains. We trust he will not think us too exacting if we stipulate that the individual in question should be able to read and write.

Mr. Vignoles explains what we described as the "crudeness" of the methods given in his previous letter by the fact that he confines himself to "general principles"; but even on this question of general principles we cannot help differing from him. He says that "all methods . . . depend on the measurement of the P.D. between the mains and earth."

Now, as a matter of fact, it is not the P.D. existing between the mains and earth at all which is measured, but the current which flows to earth when an artificial fault of known value is connected in paralled with the true leak. Thus, an electrostatic voltmeter, which is the most accurate instrument for measuring P.D.'s, will not give any results at all. A high resistance voltmeter gives inaccurate results, while the lower the resistance of the instrument employed the better. Of course, a limit has to be set for various reasons, such as the danger of temporarily raising the pressure of the other main and so forth. These are, however, some of the "details" upon the discussion of which Mr. Vignoles does not appear to wish to enter, and it is with his "general principles," as explained above, we cannot agree.

Everett, Edgcumbe & Co., Ltd.
Kenelm Edgcumbe, *Director*.

Westminster 26*th*, 1905.

I have read with interest the various proposals which have been put forward in your "Correspondence" columns for dealing with the above, but it appears to me that one important factor has not been sufficiently considered. I refer to the capacity-current flowing between main and main, and between main and earth in every alternating current system. I would like to know how the various instruments which have been proposed will differentiate between the leakage-current, pure and simple, due to defective insulation, and the capacity-current, which always exists, no matter how perfect the insulation of the system may be. We know that in some systems the capacity-current may be many times greater than a $\frac{1}{1000}$th part of the working current; whereas the leakage detector is supposed to indicate any leakage current whatever in excess of this value. In such a case small leakage effects might be entirely masked by capacity-currents, more particularly when we remember that the two are in quadrature.

With regard to the differential transformer arrangement proposed by Messrs. Everett, Edgcumbe & Co. in your issue of June 16th, I think most engineers who have experimented much with current transformers will agree with me that there is a considerable difficulty in obtaining an exact transformation ratio in different current transformers built in exactly the same way, and in maintaining these exact ratios over a large range of current. The accuracy here necessitated is best appreciated when we consider that the current transformers may be passing anything from zero to full load, and that throughout this range a leakage-current from any one main of only $\frac{1}{1000}$th part of the working current must be indicated by a constant deflection. In such a transformer we have opposing windings, each representing a considerable number of ampere-turns, and producing corresponding magnetic leakages, but these must be so exactly balanced that a diminution of the current in one winding equivalent to 0·1 per cent. of full load current produces practically the same effect in the secondary at all loads. My own experience tells me that the *apparent* leakage indicated by such a device would be a function of the load!

Messrs. Everett, Edgcumbe & Co. further suggest placing a suitable ammeter, suitably protected, in the earth connection from the neutral point. Passing over the difficulty of suitably protecting an ammeter from damage due to short circuits which shall record $\frac{1}{1000}$th part of the working current, I would ask whether it has been overlooked that there may be, and generally is, a current passing to earth along the neutral-to-earth connection, even though the system be perfectly insulated elsewhere and perfectly balanced. It has several times been demonstrated that where a triple frequency harmonic is generated in each of the leg windings of a star-connected generator, although no such harmonic appears in the wave form of the voltage taken between main and main, yet it gives rise to a capacity current along the neutral-to-earth connection; this capacity current being due to the triple frequency may have an amplitude which is large in comparison with a $\frac{1}{1000}$th part of the working current. The value of this capacity current will also vary with the external conditions. It is not clear to me, therefore, how leakage-current due to defective insulation is to be differentiated from this capacity current. It is, of course, obvious that instruments may be supplied and connected in circuit, as indicated by Messrs. Everett, Edgcumbe & Co., but it is quite another question whether the indications obtained are solely due to defective insulation, or are caused by other effects entirely.

My remarks refer more particularly to systems possessing considerable lengths of cable working at the higher voltages.

M. B. Field.

Hollinwood, *June 27th*, 1905.

PARLIAMENTARY.

The Telephone Agreement.

Tuesday, June 27th.

Mr. Stuart Wortley's Committee of the House of Commons on Tuesday held a further sitting.

Mr. A. H. Carden said that for three years he was the chairman of the Telephone Committee of the Brighton Corporation, and retired from the chairmanship on November 9th last. He was chairman during the period of the construction of the Brighton Exchange system, and he was still a member of the Committee. They applied for a licence in 1900, and received it for a term of 26 years. The maximum rates were £7 for unlimited service and £3 10*s*. for a limited service with a toll of 1*d*. per call. They had 2,000 subscribers at a capital cost of £48,000. The Corporation had now 1,749 instruments connected with the exchange exclusive of private telephones. There were a number of people who rented telephones and were not connected to the exchange. For the year ending March 31st, 1905, their income was £6 987, and after payment of all interest and charges there remained a balance of £413. He thought the agreement required amendment with regard to preventing the Telephone Co.'s cutting rates. What they feared was this, that the National Telephone Co. would be able to charge a high rate for subscribers in Hastings and Worthing and such places, and by reason of the profits made in these places would be able to introduce an absolutely cutting rate into Brighton. If the National Telephone Co. could destroy their Corporation undertaking by cutting rates during the next two years,

then they could in the following four years raise their rates, and this would affect the Post Office, who would have to pay the good-will. They had not granted the National Co. any underground wayleaves in Brighton, and they strongly urged that in competitive areas the Post Office should not allow the National Co. to go underground as was proposed under the agreement. What the Postmaster-General proposed was to demise his own rights to go underground to the company, during the intervening period of six years. As a matter of fact, the Postmaster-General had given them a verbal assurance that he would not exercise his rights during the six years, but they would like that stated in the agreement. In Brighton they went into the business knowing that they would have an underground system and that the National Co. would not. If the Postmaster-General allowed the National Co. to lay an underground service, then at the time of purchase, the Postmaster might purchase the National Co.'s system and leave the Corporation alone. He strongly endorsed the opinion that local authorities could manage local services much better than a central authority. He must admit that there was nothing specifically stated in the agreement which would prejudice municipal services, yet he felt that unless the Committee pointed the matter out, the Post Office would take the whole service over.

By Mr. HELME: The maximum charge of the Brighton Corporation was £7 10s. for an unlimited service, but they actually charged £7 10s. The National Co.'s charge for the unlimited service was £10, but nobody took it. Since the competition the company had introduced a new service which worked out at about 50 per cent. less than the old rates.

Mr. HELME: Do you suggest that the National Co. are offering terms which do not pay them?—Undoubtedly. It is entirely unremunerative. They are losing money very largely in Brighton.

The CHAIRMAN: It is dumping.

Further examined, WITNESS said the Corporation had 1,750 subscribers and the National Co. 2,500 subscribers in Brighton.

Replying to Mr. BENN, WITNESS said the rates scheduled in the agreement were absurd. They were absolutely unremunerative, and could only have been put in to kill municipal competition.

Mr. Alderman J. W. SOUTHERN said he represented the Manchester Corporation and other corporations. He was a member of the Committee appointed to consider telephone matters. The National Co. held a license for the Manchester area of 180 square miles. They brought together a conference of County Borough Councils and other authorities in 1905, and that conference passed a resolution strongly objecting to the proposed telephone agreement. The Manchester Telephone Committee had been constituted to try and obtain a municipal service, but difficulties had arisen owing to the size of the district. If it were shown that it would be left an open matter whether hereafter Manchester should be allowed to establish its own municipal system, that would greatly remove his objection to the agreement. He was desirous that cities which had not established their own telephone services should not be prejudiced in the future. In Manchester itself the National Co. had 6,235 telephones, and if the Glasgow rates of £5 were in existence in his town, it would mean a saving of £30,000 a year to the community. He could not point to anything in the agreement which would prevent the establishment of municipal services, but it was well-known it was the intention of the Post Office to work the system itself. Anything like incapacity would be more criticised if the authority giving the service were the local authority. In 1900 the Corporation entered into negotiations for the purchase of the National Co.'s plant, but they led to no result. He thought if in the next two year's municipalities were granted facilities to telephone their towns there would be no difficulty in installing the systems. They at present received £1,700 as rent for the underground wayleaves from the National Telephone Co., and they would lose this by the Post Office agreement.

Mr. F. B. MAINGUY, President of the States Telephone Council of Guernsey, was then called. He said that there were no telephones in the island prior to the year 1896, although the Telephone Co. had offered to commence a system, but on terms which were considered prohibitive. The want of a telephone service was very much felt, and the matter was discussed by certain of the inhabitants in 1896. The National Telephone Co., who had previously asked £10 per annum per subscriber, and had then reduced this figure to £8, in view of the strong probability of an independent exchange being started offered to "telephone" the island for £6 10s. per annum and upwards on a 5 years' agreement. The offer was not accepted, and the States of Guernsey determined on June 17th, 1896, to apply to the Postmaster-General for a licence, and to establish a system of telephones of their own. The Post Office, after considerable correspondence, expressed a desire to undertake the telephoning of the island itself, and sent over a Commission under Major von Donop, R.E. However, on learning what tariff the States were proposing to introduce, the Post Office indicated that it was not prepared to undertake the work on such terms, as they would prove unremunerative. After much opposition on the part of the National Telephone Co., the licence was granted on December 31st, 1897. The National Telephone Co., finding no encouragement in its offer to telephone Guernsey, had proceeded in May, 1896, to erect numerous overhead wires in the town of St. Peter Port without complying with the police regulations, and the police accordingly cut the wires down. The company had no *bond-fide* subscribers, and in his (witness's) opinion the wires were an obstruction to the plans of the States. The licence having been obtained a comprehensive system was organised, and on July 28th, 1898, the exchange commenced to work. The tariffs as first established were as follows:—

(*a*) £1 10s. per annum, with a toll of 1d. per outward call up to 250 calls in any one quarter, after which for the remainder of the quarter extra calls beyond the 250 were charged for at the rate of 1d. for five calls.

(*b*) £2 10s. per annum, with a toll of ½d. per outward call up to 250 calls. Extra calls beyond 1,520 for the remainder of the year being charged for at the rate of 1d. for five calls.

(*c*) £5 13s. 4d. to cover 4,000 outward calls. Extra calls beyond the 4,000 for the remainder of the year being charged for at the rate of 1d. for five calls.

The charge for the use of public telephones was, at first, 2d. for non-subscribers, and 1d. for subscribers for a call not exceeding five minutes' duration.

After about three years working, it was found that those charges afforded a sufficient margin of profit to warrant a reduction, and it was therefore determined to reduce them in some respects. (*a*) was unaltered, (*b*) was altered to £2 5s. per annum, with a toll of ½d. per outward call until 1,320 calls in any one year was reached, after which the rate was 1d. per five calls; (*c*) was altered to £5 per annum to cover 3,200 outward calls in any one year, after which for the remainder of the year the charge was at the rate of 1d. for five calls; and the charge for the use of public telephones was made 1d. both for subscribers and non-subscribers. Those charges were the present charges, and it had been found that the undertaking was still working at a profit. The surplus for 1904, after paying the Post Office royalties, was £281, the amount of the Post Office royalties having been £432 16s. 3d. On December 31st, 1904, the number of lines was 1,375, and, as the population of the island was 40,000, it meant one telephone to every 29 persons. Guernsey was, therefore, the best telephoned area in the kingdom. The capital expenditure at December, 1904, stood at £23,590 5s. 3d., in addition to which £2,885 5s. 10d. had been expended on the purchase of land, and the erection of buildings. The capital cost per working instrument was, therefore, £17 3s. 1d. The total revenue for 1904 was £4,546 8s. 9d., the average revenue per instrument per year being £3 6s. 1½d. Since the commencement of the undertaking, £5,086 9s. 10d. had been set aside for sinking fund and depreciation.

In conclusion, WITNESS said that the States of Guernsey viewed with great apprehension the prospect of an increase in the tariffs after the expiration of their licence in 1911.

Mr. Alderman FREDERICK LABARD, Mayor of Hull, and deputy-chairman of the Telephone Committee of the City Council, was the next witness.

(To be continued.)

L.C.C. Tramways.

Monday, June 26th.

ON Monday Mr. Kearley's Select Committee of the House of Commons reassembled for the purpose of further considering the London County Council's Tramways Bill. It will be remembered that at the last sitting of the Committee, a month ago, the preamble of the Bill was found proved, subject to the widening of Blackfriars Bridge, which, the Committee insisted, was necessary before tramway could be allowed to cross.

The L.C.C. were represented by Mr. Erskine Pollock, K.C., and Mr. Moon, K.C., and Sir Ralph Littler, K.C., and Mr. Vesey Knox appeared for the City Corporation.

Sir RALPH LITTLER, on behalf of the City, submitted to the Committee a clause which provided that no part of Tramways No. 1A, No. 1B and No. 2, and No. 2B should be constructed until Blackfriars Bridge had been widened or reconstructed by the Corporation or until another bridge had been constructed for the purpose of carrying the proposed tramways. He said that the clause was for the protection of the Corporation, and if it were not inserted there would be nothing for the Committee to do except to find the preamble of the Bill not proved.

Mr. ERSKINE POLLOCK said that, to his mind, it did not seem to be quite in accordance with the virtual agreement which had been arrived at that the City should dictate to the County Council as to how far the tramways should be constructed inside the Council's own district.

The CHAIRMAN interposed with the remark that perhaps the Committee might facilitate matters, and so avoid a lengthy discussion, if he were to say at once that they (the Committee) would certainly adhere to their decision that, until the bridge in question was widened, they would not give their sanction either to the tramways coming over Westminster Bridge or going along the Embankment. The Committee had the fullest confidence in the Corporation, and they wished to express their appreciation of the public-spirited way in which the Corporation had met their (the Committee's) suggestion. The Committee had perfect confidence that the Corporation meant to widen the bridge, and he thought it would be rather unfair to the Corporation to allow the trams to come on to the Embankment before that widening was carried out. It had been laid down and recognised that the circular route was imperatively necessary; but if the Committee allowed the trams to come on to the Embankment and remain there before the circular route was opened, he thought it would be merely bringing a nuisance on to the Embankment, and that the Committee wished to avoid. They considered, therefore, that it would be better if the circular route were carried out in its entirety.

Mr. POLLOCK: That settles the question then?

In reply to a member of the Committee, Sir RALPH LITTLER said that he asked that the tramways should "not be allowed to be commenced to be constructed, &c." All he asked was that the usual course should be followed.

The CHAIRMAN: You do not want to lay down any hard-and-fast line? Are you prepared to agree that, with the consent of the Corporation, they may commence their works?

Sir Ralph replied that he thought he could go as far as that. He was willing to insert after the word "shall" in the clause, the words "except by consent in writing of the Corporation, &c."

Mr. Pollock agreed to this. He said that he had been requested by the County Council to express their very cordial appreciation of the way in which they had been met by the Corporation in this matter, and of the manner in which leading members of the Corporation had urged the necessity of the tramways as a matter of public interest.

Sir Ralph Littler remarked that he could only say that the Corporation had never willingly put any obstacles in the way of traffic facilities in London.

The Corporation's clause was then added to the Bill, and the other clauses were adjusted.

A clause was brought up by Mr. Vesey Knox to provide that the cars should not be allowed to stop on the bridges.

Mr. Pollock asked what would happen if they were held up by a City policeman.

After further discussion, the clause was amended so as to provide that the cars should not stop "for the purpose of picking up or setting down passengers" within 25 yds. of the bridges or their approaches.

A clause protecting the District Railway Co. was then inserted, and the remaining clauses having been adjusted, the Committee adjourned.

Metropolitan Electric Tramways Bill.

The newly elected Chairman of Committees of the House of Commons, Mr. Grant Lawson, had before him on Wednesday, June 21st, the Bill promoted by the Metropolitan Electric Tramways Co. The Bill was unopposed.

Mr. Pritt, the Parliamentary agent, said that the promoters sought to carry out considerable street widenings in Edmonton. The proposal was to widen certain of the streets to 50 ft., and against this the Middlesex County Council originally presented a petition, seeking to enforce a width of 66 ft. An agreement had, however, been arrived at, under which the County Council undertook to raise the money for carrying out the widenings to 60 ft., amounting to £63,000, the company agreeing to pay interest at the rate of 4½ per cent. on £37,000, which was equivalent to 6½ per cent. on £27,000, the cost which would have been involved if the widenings had been made only 50 ft. The agreement now formed part of the Bill.

Mr. J. Devonshire, the managing director of the company, having proved the preamble in evidence, said, in answer to the chairman, that the company bound themselves to pay 4½ per cent. interest during the remainder of the term of the company's ownership, which came to an end in 1925. The Middlesex County Council, as the purchasing authority, would then take over the tramways as a going concern.

Certain minor amendments in the arbitration clauses having been made, the chairman declared the preamble proved, and ordered the Bill to be reported for third reading.

Administrative County of London and District Electric Bill.

The Select Committee on Standing Orders of the House of Commons on Tuesday considered the report of the Examiner that the Standing Orders not previously inquired into, and which were applicable thereto, had not been complied with, inasmuch as no notices have been published in the *London Gazette* or local newspapers of the powers sought by Sub-sections (2) and (3) of Clause 96 of the Bill, for protection of the South Metropolitan Gas Co. The Committee resolved that the Standing Orders be dispensed with unconditionally.

The *Times* says that the Standing Orders Committee, having decided to allow this Bill to proceed to the second reading, despite the technical non-compliance reported by the Examiner, the Chairman of Ways and Means will fix an evening sitting next week—probably Tuesday or Wednesday—for its consideration by the House of Commons. The measure, which has come down from the Lords, is opposed by the London County Council on the ground that it contains proposals prejudicial to the local authorities, and calculated to create dangerous precedents; and notwithstanding that a clause has been inserted specially protecting the interests of the present lighting authorities (who claim to derive only 6 per cent. of their revenue from the sale of power, and supply less than 4 per cent. of London's total power requirements), the second reading stage may therefore be expected to lead to considerable discussion on points of principle. A deputation representing the promoters was to be received at the Board of Trade on Wednesday.

Andover Lighting and Power Bill.—The Lord Chairman of Committees reports that all opposition to this Bill has been withdrawn, and it is accordingly taken from the group and committed to the Unopposed Bill Committee.

Second and Third Readings.—In the House of Lords on June 27th the Dublin United Tramways Bill was read a second time.

In the House of Commons on the same day the Metropolitan Electric Supply Co. (Acton District) Bill was read a second time.

In the House of Commons on June 26th the Metropolitan Electric Tramways Bill was read a third time.

In the House of Lords on the same day the following Bills were also read a third time, and passed:—Central Electric Supply Bill, County of London Electric Supply Co. Bill (with amendments), London United Tramways (extension of time) Bill.

In the House of Commons on June 21st the following Bill was read a third time:—The Shropshire, Worcestershire and Staffordshire Electric Power Bill. The following was read a second time:—The North Metropolitan Electric Power Supply Bill.

LEGAL.

Julius Sax & Co., Ltd.—Watnpach *v.* the Company.

In the Chancery Division of the High Court on Friday, before Mr. Justice Swinfen Eady, Mr. Ford said he had a motion on behalf of plaintiff and all other debenture holders for the appointment of a receiver and manager of the company, which carried on an electric light and ironmongery business. The whole issue was £1,200, of which plaintiff held £600. No interest had ever been received by him. It was thought that with the assistance of a receiver and manager the business might be carried on at a little profit.

His Lordship: Is it a flourishing business?

Mr. Ford said he had no affidavit on that point. The company did not object to the appointment of a receiver and manager.

His Lordship: But I object to appointing a manager without seeing the propriety of it.

Mr. Ford said he would produce evidence on that point.

His Lordship directed that the motion should stand over till this was done.

Glover *v.* Lever.

In the Shoreditch County Court, before his Honour Judge Smyly, K.C., last week, this case was heard. It was a claim by Messrs. Glover & Co., electrical engineers, &c., of Garrick Street, Strand, W.C., to recover the sum of £2 17s. 6d. from Mr. Lever, also an electrical engineer, of Dalston.

In opening the case for the plaintiff, Mr. Baker said that the claim had been remitted from the High Court, and was for the recovery of the balance of an agreed price for a motor, and, in addition, a new starting box. The motor was supplied for £20 10s., but shortly afterwards the starting box went wrong; as a new one had to be supplied, they charged £2 7s. 6d. for it, and the balance, 10s., was owing on the motor.

Mr. Moore, for defendants, said the case turned on whether the first starting box supplied was faulty or not.

The Plaintiff said the starting box that was first supplied was a good one, and the fact that it went wrong must have been caused by the coil burning out in consequence of the switch being left on.

His Honour examined one of the starting boxes.

The Defendant said that at the time he purchased the motor he was not an electrical engineer, but had since become one in a large way of business. The motor was used correctly, but broke down in some unaccountable way. He received no directions with the motor as to how he was to use it.

His Honour said he could not find any evidence that the motor was defective when supplied, and found for the plaintiffs with costs.

An Electric Motor Dispute.

In the Lord Mayor's Court last week, before Mr. F. S. Jackson and a jury, the case of the Refuse Destructor Co., Ltd. (in liquidation), *v.* Toshinsky was heard. The plaintiffs claimed £10 10s. in respect of certain repairs to an electric motor machine, at the request of the defendants, saw mill proprietors, of Hanbury Street.

The plaintiffs' case was that in the autumn of 1902 the plaintiff company supplied the defendants, Messrs. Toshinsky & Ruchkovitz, with a 20-H.P. electric motor engine, for use at their saw mills, for the sum of £135. At the end of 1902, the defendants requested the plaintiffs to see to the motor because it had got out of order. The plaintiffs' engineer, Mr. Wiltshire, upon going to the saw mills, found that the motor had been subjected to negligent treatment. The repairs now sued for were in respect of a sum of 10s. for heated bearings which were put right, and the sum of £10 for repairing a burnt-out armature. When the motor was fitted up by the plaintiffs, the defendants were instructed that it would be necessary to clean the machine from time to time, and not to allow hardwood dust and oil to accumulate, or it would cause trouble to the machine. The motor being used in a saw mill could not be kept absolutely free from dust, but the defendants were told that it would have to be kept reasonably clean. The defendants had, however, allowed an accumulation of wood dust and oil to occur, causing the damage to the armature for which they were claiming to be paid. The defendants had alleged that the damage done to the motor was covered by the guarantee which the plaintiffs had given to repair the machine for a period of six months. The plaintiffs, however, had only contracted to put right any mischief caused by defective workmanship or defects in the machine. The question for the jury was whether the damage to the armature was caused by such defects, or whether it was caused by negligent treatment.

Mr. Edward Wiltshire, formerly engineer in the employment of the plaintiff company, was called, and gave evidence. He said that when the motor was fitted up he made a general statement to them as to the care of the machine, and that it was to be kept

reasonably clean. No damage would have come from a slight covering of hardwood dust, but immediately the hardwood dust got excessive and impregnated with other substances it would become a conductor of electricity. Such an accumulation would break down the insulation. He had told the defendants that his firm could not be responsible for faults caused to the machine by their neglect. Cross-examined, the witness said that the distance from the motor to the main shaft was 23 ft., and in consequence of their being unable to dig a trench for the belting they had to erect a countershaft. He did not think all the trouble was caused by the erection of the countershaft. The original estimate was for a direct drive to the main shaft.

For the defence, Mr. Edward Keil, an engineer, who had been in the defendants' employment for about 18 months, said that when first employed the electric motor was connected to a countershaft. The distance between the countershaft and the motor was about 9 ft., and it was impossible to get the motor to work properly, and they could never get a 20-h.p. drive out of it. The effect of so short a drive was, that the belting was required to be so tight that the bearings became heated immediately. He had altered the length of drive and connected the motor to the main shaft, and it was now working beautifully, and he had had no trouble with it since.

After hearing the evidence of Mr. S. Ruchkovitz, a member of the defendant firm, and other witnesses, the jury found a verdict for the plaintiffs for the amount claimed.

Forward Engineering Co., Ltd., *v.* The Banbridge Foundry Co.

This was an application made to the King's Bench Court at Dublin last week by the plaintiff company for an order that the verdict and judgement for the defendants at the trial of the counter-claim before Mr. Justice Madden and a special jury be set aside, and that a new trial be ordered, or in the alternative that judgement be entered for the plaintiffs, on the grounds that the jury disregarded the direction of the judge at the trial, that the jury findings were inconsistent, and other grounds. The counter-claim in the action was for breach of contract in the sale of an engine by the plaintiffs' company for the defendants' company at Banbridge, for which £143 was claimed by plaintiffs, and that amount was lodged in Court. The jury had found for £204 16s. 7d.

Mr. Gordon, K.C., opened the arguments for the plaintiffs, and read the evidence given in the Court below. Counsel had not concluded when the Court adjourned.

Llanrwst Electricity Supply Co., Ltd., *v.* Llanrwst U.D.C.

This case was mentioned on 23rd inst. before Mr. Justice Warrington in the Chancery Division. Mr. Hewitt, for the plaintiffs, said he had a motion for an injunction to restrain certain alleged water rights of plaintiffs being interfered with by the District Council. It was a case which depended on a number of documents of a very complicated character, and Mr. Rowden, K.C., for the defendants, agreed that the proper course was to let the case stand for speedy trial. It was an urgent case, because plaintiffs' business depended on having this supply, and pleadings would be necessary because of the complicated documents.

The case stood for trial accordingly.

Benfleet Electric Light and Engineering Co., Ltd.

According to the *Financier*, there was last week a petition in the list by H. Rowsell for the winding-up of this company, but on its being called there was no appearance.

Lloyd's *v.* The Marconi International Marine Communication Co.

On Tuesday, before Mr. Justice Kekewich in the Chancery Division, a motion was brought forward to accelerate the hearing of an interlocutory summons for further and better answer to affidavits of documents.

Mr. Gover, in making the application on behalf of the company, said the action was a very heavy one, and it was desirable that the summons should be heard before the action.

Mr. P. Ogden Lawrence, K.C., for plaintiffs, said he did not wish to put any obstacle in the way of hearing the summons for further documents, but there was a difficulty with regard to that part of the summons in which the Attorney-General was concerned.

After some discussion, Mr. Gover consented to abandon the claim to the production of documents on which there was a claim of privilege on the ground of their being State documents.

His Lordship agreed on this condition to expedite the hearing of the summons.

Nuisance Action.

An action was recently heard in the High Court, Edinburgh, in which a legal gentleman sought to interdict a firm of electrical engineers and plumbers, Messrs. Burn Bros., from using a motor on their premises. He stated that the noises and vibrations were extraordinary, "like that of a ship's siren or foghorn, with loud drumming vibrations like a thrashing mill, and shrill, piercing shrieks." The defence was that the noise was not a nuisance, and that if the complainer kept his windows shut he would not be disturbed.

ELECTRICAL WORK IN EGYPT.

As very little information is generally available in regard to the condition of the electrical industry in Egypt, it may be of interest to refer to an article on the subject which was published in a recent issue of the *Elektrotechnische Rundschau*, and which has apparently been abstracted from a German Consular report, although it is not acknowledged as having been so derived. The matter was briefly touched upon in our "Business Notices" last week. The first matter which may be considered is as to the relative position occupied by different countries in meeting the requirements of Egypt in respect of electrical machinery and manufactures. This point is illustrated by the following table, which shows the value in Egyptian pounds of the goods imported into Egypt from the countries mentioned in the past four years:—

Value of Electrical Imports.

From	1904. £ E.	1903. £ E.	1902. £ E.	1901. £ E.
Great Britain	44,497	31,029	30,024	23,099
Germany	16,331	14,313	6,559	4,314
France	8,253	8,234	6,326	6,877
Sweden	5,192	1,856	929	2 208
United States	5,171	517	1,205	67
Austria-Hungary ...	4,314	3,444	2,676	2,622
Belgium	3,490	1,020	1,534	685
Italy	3,336	1,086	3,072	1,904
Switzerland	2,903	6,178	929	75
Total	£ E. 93,357	67,677	55,222	41,851

(Including imports from other and unenumerated countries.)

It will be seen from the table that the demand for electrical productions is increasing year by year, and that Great Britain continues to hold the first position in supplying them. The fact, however, should not be overlooked that the imports from several other countries, as demonstrated by the values, have advanced in a considerably greater proportion than those from Great Britain. The way to promote business, if the concluding lines of the article may be mentioned at this early stage, is to have a reliable and expert representative in the country. Proceeding, now, to refer to the work in the towns, we first come to Cairo:—

The Work in Towns.—The principal parts of Cairo are provided with the electric light for private houses, the concession being held by the Compagnie Centrale d'Eclairage par le Gaz—that is to say, Eugene Lebon & Co. There is no public electric lighting, owing, it is said, to the opposition of this gas company. A network of electric tramways, the property of the Société Anonyme des Tramways du Caire, is in existence. The company is domiciled in Brussels, and has a share capital of £240,000, in addition to founder shares and bonds. In Alexandria, the same gas company furnishes the electric light to private consumers, and as in the case of Cairo, public electric lighting is unknown. The electric tramways which were originally established by M. Cauderay, are now in the possession of Egyptian capitalists. The headquarters of the Société Anonyme des Tramways de Alexandrie, which has a share capital of £320,000, are at Brussels. The concession for the formation of a connection between Alexandria and its eastern suburbs is in the hands of the Alexandria and Ramlah Railway Co., Ltd., which recently converted the system to electric traction. The latter company has also taken over the working of the town tramways, and its general manager is also the working manager of the latter lines.

The electric light has been recently introduced into Port Said, and, in point of fact, by the identical gas company which operates in the two former cities. An electric tramway has not been constructed in Port Said, which only possesses a horse tramway. In Tantah, the firm of E. Nahman & Co. obtained a concession in 1901 for both public and private electric lighting for a period of 20 years, and later on the concession was extended to 30 years, and transferred to the Société Electrique de la Basse Egypte. The Mansourah Electric Supply Co. obtained a 20 years' concession in 1899 for both public and private supply in Mansourah, while at Ismailiah a concession for private lighting has been granted to the Société Electrique d'Ismailiah, which was formed by German and Swiss capitalists, and stands under German protection. In 1903 the latter company took over the contract for electric lighting in Suez and Port Tewfik, which was originally entered into with the firm of H. Beyts & Co. for a period of 20 years.

Electric Transmission of Power.—The article proceeds to discuss the question of gas engines for power purposes in connection with irrigation and other works, and then deals with the electrical transmission of power. It is pointed out that the question has frequently been raised as to whether it would not be more advantageous in many cases to use electricity for the transmission of power, in which irrigation would play the first part. In general, the watering of the land is carried out by the employment of feeble implements and machinery which are distributed over a large district, and only serve to irrigate small areas. It would, however, be of considerably greater benefit to establish large power stations with modern condensing engines, driving either direct current or polyphase generators, which would supply power by means of overhead conductors for the operation in remote districts of electrically-actuated pumps located on the most suitable spots indicated by the owners of the land.

It has already been observed that such a system would be much more economical than the present methods. A French engineer, who is attached to the Administration of Domains, has already employed electrically-driven pumps for irrigation purposes, the power being supplied by a cotton factory, which only requires its plant in operation for a portion of the year. A Greek landowner

on a large scale has also established an electrical power transmission installation on his property in the neighbourhood of the Nile barrage, the work having been carried out by the Siemens-Schuckert Works Co., while the latter has also undertaken a similar plant for the Prince Djemil Tussum.

It is assumed that the largest application and development of electricity will take place in Upper Egypt. The question of utilising the Nile cataracts has already been taken into consideration. In any case it is certain that the waste lands of to-day, which are under the influence of the hot sun, could be transformed into fruitful fields if the waters of the Nile could reach them, and that, too, by the power realisable from the Nile itself. The accomplishment of this idea, however, is perhaps a matter of the remote future, but it is mentioned that the sluice gates of the Assouan dam are operated by electrical apparatus furnished by the Siemens-Schuckert Works Co.

Apart from the tramways in Cairo and Alexandria, there are no important applications of electrical transmission of power in Egyptian towns. It is only possible to cite the electric hoists with two-phase current which are used for the lifting of bales of cotton by the Société de Pressage et Depôts de Coton in the Minet-el-Bassel district of Alexandria. The apparatus is partly of German and partly of French origin. The employment of electric power by private individuals is limited, owing to the comparatively high cost of production due to the price of coal, but petroleum is cheaper, and the oil motor is, therefore, more economical than the electric motor. However, other considerations have induced certain manufacturers in Cairo and Alexandria to adopt electric motors, as, for instance, the point where the power has to be applied, noiselessness in working and cleanliness. No one has, singularly enough, thought of introducing electric lifts in the large blocks of dwellings having lofty floors, and in which electric power could be used to advantage.

Installation Material.—A certain amount of success has attended the introduction of ventilating fans in the hot climate of Egypt, although competition has caused prices to fall to a low level. The ventilators are obtained from England, France, Germany, America, Italy, Belgium and Switzerland. With regard to internal electric lighting, it is mentioned that the mistake is frequently made of looking at the cheapness of prices without taking into consideration the quality of the materials. In these circumstances good articles should be offered as low as possible, and only that amount of labour should be devoted to their production that is necessary, superfluous finish being avoided. Unfortunately, joiners and tinsmiths import inferior material from Europe and place themselves forward as electricians, but although the Government and the companies seek to counteract this abuse, they avoid the appearance of favouring individual contractors, and hindering the workmen from earning a living. There are happily various good firms whose work leaves nothing to be desired, but in all the circumstances of the case, it is specially important for exporters to Egypt to have reliable and technical representatives on the spot.

BUSINESS NOTES.

British Apathy in Motor-Omnibus Building.—The following letter has been addressed to us:—

With reference to the very caustic yet timely remarks recently appearing in the Press on this subject, I beg to point out that the British Empire Motor Trades Alliance was established for the purpose of encouraging the use of British rather than foreign manufactured cars within the British Empire and Colonies. Recognising the fact that the invasion of this country by foreign motor-omnibuses can only be stemmed by combined action, I have to request that British motor-omnibus manufacturers will immediately communicate with the Alliance, and their names will be placed on the Register of British Manufacturers we are now compiling. Motor-omnibus buyers will be approached, and every legitimate step possible taken to obtain preference for the home industry, lists of British manufacturers will be circulated, also inquiries from buyers invited, and copies of the inquiries will be sent to all firms whose names are on the Register.

J. B. King, *Secretary.*

Colliery Installations.—The following is a list of important colliery contracts that have been booked by Messrs. Bruce Peebles & Co. within the last month:—

Lambton Collieries, Durham, 2,800 H.P. in hauling, pumping, and ventilating motors. Average size, 150 H.P.

Risca Collieries, South Wales, 1,800 H.P. in pumping and hauling. Average size, 180 H.P.

Darbishires Quarries, North Wales, 1,500-H.P. motors, varying from 50 to 150 H.P.

Bow Hill Collieries, 500 H.P. in pumping and hauling.

The total H.P. aggregates over 6,000, and the value of the orders aggregates over £40,000.

Earl's Court Exhibition.—We recently paid a visit to the Naval, Shipping and Fisheries Exhibition at Earl's Court, and found there abundance of interesting material for examination—indeed, the exhibition is one of the best that we have seen at Earl's Court. An excellent collection of naval relics has been brought together, of which the most noteworthy exhibits are the numerous items directly associated with the person of Nelson, our greatest naval hero; other collections appertain to the memory of Collingwood, Howe and Benbow, and there are interesting souvenirs of the explorations of Cook, Franklin and other distinguished explorers. Models of modern battleships, cruisers, liners and yachts are shown in great variety, and the representative exhibits of naval and military guns, from 12 in. down to Maxim, are of absorbing interest.

Of general engineering exhibits the most noteworthy, from an electrical standpoint, are those of Messrs. Davey, Paxman & Co., who show a number of gas and oil engines, a suction gas producer vertical tubular boiler, and portable steam engine; Messrs Babcock & Wilcox, marine type water-tube boiler, bucket conveyor, models, &c.; the Stirling Boiler Co., marine type boiler and models; Greenwood & Batley, De Laval steam turbo-dynamo, electric drill, &c.; Messrs. Crossley Bros., suction gas plant and direct-coupled gas dynamo, and an oil engine, the former running 176 16-c.p. lamps and 4 arc lamps at a cost for anthracite coal of 2¼d. per hour. Mention should also be made of Messrs. Kelvin & James White's exhibit of Lord Kelvin's navigational instruments, and the Long-Arm System of closing electrically-operated watertight bulkhead doors, while, of course, there are many other items less directly associated with electricity.

The recreational side of the exhibition is as attractive as ever, and affords a pleasant change from the more technical and commercial aspects of the undertaking; but our readers may safely be left to investigate this department for themselves.

Names Wanted.—The British Empire Motor Trades Alliance has received an inquiry for the names and addresses of British firms who press by machinery planished steel or aluminium bucket seats for automobile bodies. Firms who can fulfil these requirements are requested to communicate with J. B. King, secretary, at 11, Red Lion Square, W.C.

Battery Contracts.—The following orders have been placed with Messrs. Pritchetts & Gold, Ltd.:—

Bedwellty Union, 125 300-ampere-hour cells.
Imperial Railways of North China, 120 550-ampere-hour cells.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co.:—

For the Falkirk Tramways (per Bruce Peebles Co.), three double-deck car bodies mounted on Brush standard A.A. type trucks.

For the Yorkshire (Woollen District) Tramways, six single-deck car bodies mounted on four-wheel trucks with Brush 1,002B motor equipments, and four single-deck car bodies mounted on radial trucks with Brush 1,002B motor equipments.

For the Cavehill and Whitewell Tramways (per J. G. White & Co.), 10 tramcars complete with Brush motor equipments.

France.—A company has just been formed in Paris (7, Rue Baltie), with a capital of £1,200 and the title La Societe de l'Accumulateur Phenix.

The report of the Societe Lyonnaise des Forces Motrices du Rhone, of Lyons, for the last financial year, shows a profit of £61,828, as compared with only £45,840 in the preceding 12 months.

Russia.—La Compagnie d'Electricite du Mide de la Russie, of Brussels, reports a profit of £5,508 for the last financial year, as compared with only £4,364 in the preceding 12 months.

Imports of Electrical Apparatus.—While the importation of foreign electrical machinery into this country appears to be decreasing, that of electrical goods and apparatus is steadily moving upwards. The imports in May last, according to the returns just issued, were the largest so far recorded, totalling £91,947, which compares with only £75,116 in the preceding month and £60,931 in May a year ago. During the five months ending with May last the aggregate imports have attained a value of £409,284, as against only £327,928 in the corresponding five months of 1904.

Catalogues and Lists.—British Boiler Fluid and Engineers' Stores Co., Ltd., Church Row, Limehouse, E. Pamphlet relating to the cause of scale and corrosion in boilers, and drawing special attention to their "Dejecoline" boiler fluid. A separate list gives particulars of their Excelsior asbestos non-conducting boiler and pipe covering cement.

Messrs. Mestern & Co., Nachf, Berlin. Circular of their automatic closing flap for electrical ventilators.

Electrical Trades Supply, Ltd., Birmingham. New illustrated price lists of electrical porcelain ware, also damp and dust-proof electrical fittings for collieries, works, ships, &c.

Messrs. Falk, Stadelmann & Co., Ltd., London, E.C. Revised price list of their "Climax" system of steel interior conduit and fittings, enamelled or galvanised.

Messrs. W. H. Bailey & Co., Ltd., Salford. List No. 345, illustrating, describing and pricing their McCracken's patent steam trap, a new and improved pattern, with no screwed joints on the steam side.

The C. W. Hunt Co., New York. Catalogue No. 054, entitled "Manila rope transmission and hoisting." It contains a good deal of interesting matter, with some excellent illustrations, relating to the subject.

Electric and Ordnance Accessories Co., Ltd. Large picture postcard, reproducing a photograph of Osborne House, Isle of Wight, where Stellite telephones on the central battery exchange system have been recently installed.

Messrs. Geipel & Lange, Westminster. New illustrated price lists of Vulcan station testing equipment, and ammeters and voltmeters.

Parker Boiler Co., Philadelphia. Well printed and illustrated brochure fully describing the Parker double-ended boiler and its advantages.

The Mirrlees, Watson Co., Ltd., Glasgow. Illustrated list describing the surface condensing plant installed by the company at Brimsdown power station.

The Morris-Hawkins Electrical Co., Ltd., 17, Charing Cross Road, W.C. New catalogue of the Morris-Hawkins motors and dynamos. An abridged specification of the different types is followed by tabulated particulars of the protected, enclosed venti-

lated and totally-enclosed motors, also their standard shunt and compound-wound dynamos, starting switches; a table of principal dimensions is published.

Messrs. Siemens Bros. & Co., Ltd. Four new publications, as follows:—Circular YM 108, describing, in a general way, their patent electric control for steam steering gear; Leaflet 507C, giving mechanical data regarding their crane controllers; Leaflet 564, containing dimensions of the RB crane resistances; and Leaflet 563, giving dimensions, weights, &c., of Siemens G and H generators for direct coupling.

Messrs. Telford, Grier & Mackay, Ltd, 220-222, Broomielaw, Glasgow. A number of well got up pamphlets, with good half-tone and other illustrations, entitled respectively:—Transformation; transmission and utilisation of energy; electric mining machinery (chain coal-cutters and locomotives); electric mining machinery (disk coal-cutting machines); marine electrical specialities; ventilating fans.

Messrs. J. Hopkinson & Co., Ltd., Huddersfield. List No. 350 relating to steam dryers, and No. 360 on exhaust valves. The former describes the "lipless" steam dryer and receiver with sectional and other explanatory views, and gives tabulated data of prices and dimensions. The latter particularises standard straight through-way valves.

H.T. Ignition Devices.—Some ingenious novelties in the electrical equipment of motor-cars have been brought out by the H.T. Co., of Victoria Works, Charlton, S.E. Their coils are made in two grades, both guaranteed against breakdown; the A-type coils are multi-section wound and fitted with the new H.T.-high-speed trembler, which, it is claimed, ensures immunity from sticking, low current consumption, and perfect firing with the highest speed engines. The construction of the trembler is as follows (see fig. 1):—

A is a stiff steel spring having at one end a loose rivet, B, which takes the place of the ordinary secondary blade, without the disadvantage of a "time-lag," such as auxiliary blades usually have; C is a platinum stud, and D the back standard. Owing to the small

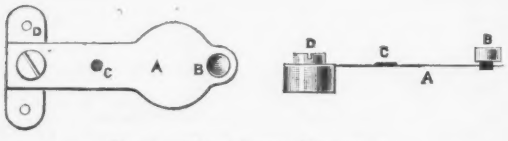

Fig. 1.—High Speed Trembler.

current passed, high speed, and correct condenser balancing, there is little or no sparking at the contacts, and because of the springiness of the trembler, the blade follows up any wear, thus obviating the need of constant adjustment.

The company make coils of all sizes and voltages, with best finish and material. Their electric governor is a very simple device, quite independent of the engine, and may be used with all cars fitted with high tension ignition. It is connected up in the primary circuit, the wire from the contact breaker on the engine being taken to one terminal on the governor, and the wire from the coil being connected to the other terminal. The governor consists of a spring blade A B, fastened at A, and fitted with a platinum stud at B. This stud is prevented from coming into contact with the platinum pointed screw C by the high resistance wire B D When the engine makes contact, the current flows along the blade A B, and the platinum points not being in contact, it passes through the high

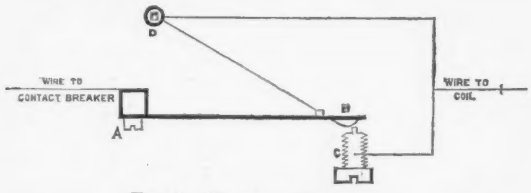

Fig. 2.—Electric Governor.

resistance wire B D, which, being heated by the current, expands and allows the platinum points to come together and pass enough current to work the coil. If the engine is running so fast that it does not make contact long enough to allow B and C to come together, the coil does not spark, and the engine misses fire and slows down. It is obvious that the engine can be set to run at any desired speed by simply adjusting the distance between B and C. An arrangement is provided whereby the governor is put into action whenever the clutch pedal is depressed, and thus prevents the engine racing; this greatly facilitates the operation of changing gear, as it is not necessary to slow the engine by hand before taking out the clutch.

Fire.—Messrs. H. N. Morris & Co. notify us that the fire that occurred at their Gorton Brook Chemical Works, Manchester, on the 8th inst., has only affected a very small portion of the departments in which their brimstone, sulphuric acid, and other acids are made. It has not in any way affected their manufacture of accumulator acids, dipping acid, and other chemicals for the electrical trade.

Book Notices.—*Nautical Technical Dictionary*, Vol. II., Part 1 (A-K). By E. v. Normann-Friedenfels, assisted by J. Heinz. Pola: Mitteilungen aus dem Gebiete des Seewesens. 1905. Price 30 marks. The first volume of this work was published in 1883, and was followed by a supplement in 1900. The present volume comprises an exhaustive dictionary of technical terms relating to the nautical profession, alphabetically arranged in English and French, and giving the corresponding expressions in both these languages, as well as in German and Italian. Besides purely nautical expressions, a vast number of words employed in allied industries, such as ship and engine building, artillery, electricity, trade and commerce, are included, making the whole a most comprehensive work, which cannot fail to be of the greatest value to many classes of user. So far as we have tested the dictionary, we have found it to meet all reasonable requirements, and our only complaint is that English words are not always correctly spelt, as, for example, "scarph" for scarf; but such slips appear to be rare. The printing is good, the type clear, and the different styles of type well chosen to facilitate ready reference. Altogether, we welcome the volume as a valuable addition to technical literature, and shall look forward to the appearance of Part II. and the succeeding volumes.

"Proceedings of the Engineering Association of New South Wales." Vol. XVIII. 1902-3. Edited by Henry V. Ahrbecker, M.I.M.E. Sydney: The Association, Royal Exchange, Gresham Street.

We have received a copy of No. 1 (June) of the *Gas and Oil Engine Record*, a monthly review edited by W. A. Tookey. Our new contemporary will deal with explosion engines of all types and with the production of gas for industrial purposes. It is published at 2, Grocer's Hall Court, Poultry, E.C., at 3d. per number.

Trade Announcements.—On account of business extensions, the National Electric Construction Co., Ltd., has from yesterday, 29th inst. changed its address to Queen Anne's Chambers, Westminster, S.W.

Messrs. Nalder Bros. & Thompson, Ltd., notify us that Mr. Ernest Roberts, 6, Holborn Place, who heretofore has had charge of their London district travelling, will not in future act in this capacity, owing to the large increase in his own business. Messrs. Frampton, Paine & Jackson, 29, Old Queen Street, Westminster, will in future represent them in London, and likewise in the southern, western and eastern counties, and those districts where they are not at present represented, for ammeters, voltmeters, watt-meters, circuit-breakers and analogous apparatus.

Messrs. Wood & Crawford, mechanical and electrical engineers, have taken more suitable premises in Queen Street, Sheffield, and are making a specialty of their improved conveying and elevating and screening machinery, and auxiliary machinery appertaining thereto. They have recently obtained the sole right of manufacture of Ford's patent heating furnace. They also undertake electrical engineering work.

Messrs. Everett, Edgcumbe & Co. announce that they have now removed their works from 151-2, Great Saffron Hill, E.C., to Collindale Works, Hendon, N.W., with offices at 87, Victoria Street, Westminster. This move (the second in three years) has been made in order to keep pace with the continuous increase of the business, and the firm have now at their disposal ample space for future extensions. They have, at the same time, as a matter of convenience, converted the business into a private limited liability company. Mr. G. J. Lemmens, who has had long experience in measuring instruments of all kinds, has joined the board.

A New Manufacturers' Association.—A preliminary circular has been issued from Orchard House, 2 and 4, Great Smith Street, Westminster, S.W., relating to a new association—the Manufacturers' Association of Great Britain—which is being formed with the object of stimulating and expanding British trade in colonial and foreign markets, by co-ordination of the industrial forces of the country, and co-operation amongst manufacturers and traders. The means to be employed are set out in detail in the circular referred to, and copies of this can be obtained on application to Mr. Ben H. Morgan at the above address.

Bankruptcy Proceedings.—Alexander Holland.—At Bolton Bankruptcy Court on June 21st the public examination took place of Alexander Holland, trading as "The Electrical and Mechanical Engineering Co.," of Farnworth. The accounts showed unsecured liabilities amounting to £325, assets valued at £31, and a deficiency of £294. Debtor stated that he commenced business in 1890 in partnership with Wm. Bullen and John Coope, neither of whom had any capital. Bullen had experience in electrical engineering, and he left nine months later. At this time the debts amounted to between £80 and £90, and debtor agreed to take them. He thought he could do better by himself. The business was never properly established, and he must have been getting further into debt all the time. The examination was adjourned in order that debtor might comply with an order to prepare a statement of accounts for the last six months' trading.

Fred Shaw.—A meeting of the creditors of Fred Shaw, electrical contractor, of 258, Hessle Road, Hull, was held on June 21st, when accounts were presented showing gross liabilities amounting to £269, and a deficiency of £81. Debtor attributed his insolvency to loss on contracts, bad trade and want of capital. He commenced business in 1901 with a capital of £15, and his father lent him £50. The estate was left in the hands of the Official Receiver for realisation.

Gerald Leslie, electrical engineer and caterer for public amusements, 5, Denning Road, Hampstead.—Receiving order made June 21st on creditor's petition.

A. E. Brooks (Brooks & Brooks), electrical engineer, 110, Cheapside, E.C.—First and final dividend, 2¾d. in the £, payable at Bankruptcy Buildings, Carey Street.

Liquidation.—Argentina Electric Traction Co. Meeting to be held at 83, Cannon Street, E.C., on July 28th, to hear an account of the winding-up from Mr. A. Clements, liquidator.

Electro-Medical Apparatus.—An electric installation is to be put into the Peebles Hydropathic for the treatment of invalids by electricity. All the most recent forms of instruments will be included, light baths, high frequency currents, static electricity, electric baths, constant and interrupted currents.

LIGHTING AND POWER NOTES.

Bourne.—Mr. W. E. Milns, resident engineer at the Stamford and Grantham electricity works, has prepared a scheme for the establishment of an undertaking in the town. This was laid before a meeting of the Tradesmen's Association on June 22nd, and is to be further considered. Possibly inquiries will be made for firms willing to erect and run such an undertaking.

Brighouse.—The balance-sheet of the Corporation Electricity Department for the past year's working shows a loss of £140 compared with a deficit of £572 in the previous year.

Bury.—The Corporation Electricity Committee has reduced the price of energy as under:—Lighting: Places of worship, schools, offices, banks, workshops, warehouses and other short-hour consumers from 5d. to 4½d. per unit; shops from 4½d. to 4d.; hotels, public houses, clubs and other long-hour consumers from 4d. to 3½d.; motive power from 2½d. to 2d. per unit, for the use of the maximum demand averaging one hour per day, or 1,000 units per quarter, the next 1,500 units per quarter 1d. per unit; beyond, 1d. per unit less 10 per cent. Public lighting, 1,000-c.p. arc lamps, from £16 to £15 per annum; 800-c.p. lamps from £14 to £13.

Chatham.—In connection with the arrangement come to between the Kent Electric Power Co. and the Gillingham Corporation for a supply of energy, Messrs. W. T. Henley's Telegraph Works Co. accomplished some smart cable work. Agreements for arranging a temporary supply were completed on the 8th inst. Messrs. Henley's were instructed to supply a main and connect up the company's network with the Gillingham station, and nearly 2 miles of three-phase 11,000-volt E.H.T. cable was delivered by them at Chatham on the 11th inst. The work proceeded through the Whitsun holidays, and although most of the cable had to be drawn by hand for nearly half a mile across the Chatham lines, the whole was laid and jointed complete by the morning of the 17th. The old feeders had to be diverted and lengthened to the extent of about 50 yards. The coal store, the only part of the station which escaped destruction, has been cleared out and fitted as a sub-station with switchboard, transformers and boosters, the latter being required owing to the pressure on the Gillingham mains being 2,000 volts, and on those in Chatham 2,400 volts. On Saturday, the 17th inst., at 5 p.m., the whole of the network was made alive, and a supply given to consumers.

Calne.—An E.L. installation is at present in course of completion at the residence of the Marquis of Lansdowne at Birwood Park. The plant will comprise a 40-H.P. Hornsby oil engine, an E.C.C. 200-ampere dynamo and a battery of E.P.S. cells of a capacity of 1,000 ampere-hours. About 850 incandescent lamps and one arc-lamp are being installed. The contract is in the hands of Messrs. H. E. Hall & Co., Tonbridge.

Continental Notes.—Italy.—A concession has been granted for the installation of a water-power plant on the River Coscile. The energy generated will be utilised for the electric tramway between Cosenza and Cotrone, and for lighting purposes at Silani.

Coventry.—The accounts of the Corporation electricity undertaking for the year ended March 31st last show a net result on the year's working, after payment of capital charges, of a loss of £229.

The Council has adopted the recommendation of its E.L. Committee to undertake the supply and maintenance of electric lamps.

Darlington.—The Corporation has decided to extend its mains to Albert Hill, an important industrial district of the borough. The Darlington Wire Works will adopt electric power instead of steam.

Dublin.—The E.L. Committee recently recommended the Corporation to instruct the city electrical engineer to prepare plans, &c., for application to the L.G.B. for sanction to a loan of £100,000 to cover the cost of providing plant to meet next winter's load, and of extensions during the next three or four years. As it is urgent that new plant be erected at once, suspension of the standing orders was also recommended, but on a division this latter recommendation was defeated.

The works at the Pigeon House have now been completed, and were inspected on Monday by the Corporation, and subsequently the General Electric Co. entertained the members and their friends to luncheon. The plant installed consists of two sets of 1,000 kw. each, and two of 500 kw. each. In addition, in consequence of the growth of the undertaking, the General Electric Co. has just laid down a further set of 1,500 kw. capacity, which is now running on the town supply.

The Corporation has expended £2,000 in dredging the harbour, which will enable steamers to come up alongside the boiler house. A travelling steam crane and grab, with track the length of the boiler house, has been installed for unloading purposes.

Ebbw Vale.—The U.D.C. has received from the L.G.B. sanction to raise a loan of £9,654 for carrying out the E.L. scheme.

Egremont.—The U.D.C. has applied for an extension of time in which to carry out the E.L. order.

Exeter.—The L.C.C. has written to the City Council with reference to the London Power Bills, stating that if allowed to become law, these were calculated to form precedents fraught with danger to the local authorities throughout the country. The City Council decided to strongly opposed the Bills.

Great Yarmouth.—The report of the working of the municipal electrical undertaking for the past financial year shows that the total receipts were £15,197, while the gross profit was £6,770. After provision had been made for interest, sinking fund, &c., the balance remaining is £1,351; the disposable balance being accordingly increased to £3,022. Of this amount £800 has been applied to reduction of rates, while £771 was expended on new works, leaving £1,451 to be carried forward. During the past four years a net surplus of £3,910 has been realised, out of which £2,100 has gone in reduction of rates, and £1,223 voted for street lighting, extensions, &c. The T.C. has decided to offer consumers an optional flat rate of 5d. per unit for all units used up to 3,000 per annum, and 4d. per unit beyond, and charge a flat rate of 2½d. per unit for power taken from lighting mains.

Hamilton.—Last week, under the auspices of the Burgh Council, an exhibition of electrical appliances was held for four days at the Commercial Hotel.

Hanwell.—An agreement with the Uxbridge Electric Supply Co. has been entered into by the U.D.C., whereby the former is to take over the prov. order for the district. The company has agreed to deposit £550 to cover the Council's expenses in the matter.

Hull.—A L.G.B. inquiry was held on June 22nd relative to the application of the T.C. for a loan of £36,000 for electricity purposes. It was stated that the Council had contracted to supply several large power consumers, the increased demand being estimated at 700 kw. The new plant to be laid down was equivalent to 1,000 kw.

India.—From the *Indian Textile Journal* we learn that electric light has been largely adopted in Bombay Mills. Messrs. Marshall & Co., of that city, are largely responsible for the work in connection with this, and among the contracts completed or now being carried out are:—The Pabaney Mills, with 650 lights, run by A.E.G. plant; the Queen's Mills, with 520 lights, energy being supplied by a Lancs. Dynamo Co.'s and Hindley-Royce plant; at the David and Standard Mills, a Robey-Westminster Engineering set supplies 550 and 600 lights respectively; Hindley-Royce generating plant supplies energy for 640 lamps at the Tricumdas Mills, and a Reavell-Johnson & Phillips set, 525 lamps at the Elphinstone Mills. There are many others, including the Khatau Mills and the Adamji Peerbhoy Mills, with installations of 1,400 and 1,600 lamps respectively.

The necessary licence has been granted by the Government of India to the Brush Electrical Engineering Co. to supply electricity to the town and island of Bombay for lighting and power purposes. Two years are allowed for the laying down of cables in the principal portions of the city. The company has proceeded with the installation of the plant, while the Government has been considering the question, and during the past year several miles of cable have been laid down, and a generating station erected. The *Times of India* understands that the company expects to inaugurate the service some time next month.

Ipswich.—The T.C. on June 21st decided to apply to the L.G.B. for a loan of £7,486 to cover excess expenditure on machinery at the electricity works, and of £5,365 for extensions of mains and house services.

London.—Southwark.—The B.C. has received from the City of London Electric Lighting Co. an offer to quote terms to supply energy in bulk. The General Purposes Committee is to consider the matter. The B.C. also resolved to overhaul and repair the battery at a cost of £250; to install a balancer and booster at a cost of £450; to erect a new fire-proof gallery and re-erect the present switchboard thereon at a cost of £320; to install a feed-water heater and purifier at a cost of £380. A loan of £6,000 is to be obtained to cover this expenditure and to pay off the over-draft of £4,250 spent on cables.

Fulham.—The Finance Committee reports for the year that on the combined E.L. undertaking, after the account has been credited with £980 from the general rate, there is a surplus of £574. Out of this amount, £250 is to be left on the revenue account as a reserve for bad debts and cash discounts, and £250 is to be placed to the machinery reserve account. The balance of £74 is to be carried forward.

Metropolitan Asylums Board.—It has been resolved to apply to the L.G.B. for a loan of £4,000 for the installation of the electric light in Belmont Asylum.

Westminster.—The C.C. is prepared to enter into a three years' contract with the electric lighting companies now supplying energy to the Council's buildings at 2½d. per unit for lighting and 2d. per unit for power upon certain conditions. The St. James's and Pall Mall Co., the Westminster E.S. Corporation, the Metropolitan E.S. Co., and the London E.S. Corporation have agreed to these terms, but the Charing Cross, West End and City E.S. Co. offers an all-round rate of 2¼d. per unit, which the Council will not accept.

The fillings of street box covers is the latest fault to be found in electric lighting systems, according to the views expressed by the City Council. The Council require the Westminster Electric Supply Corporation to fill in its box covers with material similar to the surrounding pavement.

Hammersmith.—A site is to be purchased in Scrubb's Lane for £2,500, to be used as a site for a depôt and electrical sub-station.

Battersea.—The agreement between the B.C. and the L. and S.W.R. Co. for the lighting and supply of energy for power at the Nine Elms Goods Yard has been completed, and supply commenced.

Marylebone.—At a recent meeting of the B.C., it was intimated that Mr. A. Wright, the Council's electrical adviser, has received over £9,000 in commission, which was paid on capital expended. He will probably receive some £6,000 more.

Manchester.—The Electricity Committee has recommended the T.C. to reduce the price of energy to short-hour consumers from 5½d. to 4½d. per unit from September 29th next.

Medomsley.—The P.C. has decided to have the whole of the parish lit by electricity next season; energy is to be supplied by the Consett Iron Co.

New Shildon.—The Northern Counties Electric Supply Co. has erected a new generating station and refuse destructor in the district, which was formally opened a few days ago; energy has been supplied, however, to the district for six weeks. The destructor has four cells, and is of the Heenan type, working in connection with two B. & W. water-tube boilers with a heating surface of about 3,900 sq. ft. At present the three cells working deal with about 30 tons of refuse daily. The whole supply of energy is being generated from machines driven by the destructor boilers.

Norwich.—The Electricity Committee reports that the balance carried to net revenue account for the past year is £16,574, as compared with £15,147 in the previous 12 months. After provision had been made for interest and sinking fund, the profit was reduced to £4,432. Including balances from previous years, there was a nominal surplus of £10,013 to be dealt with. Of this sum, £9,760 is proposed to be applied to making good depreciation of machinery, &c., leaving £253 to be carried to the credit of 1905-6. The number of units sold in 1904-5 was 2,097,942, as compared with 1,819,708 units sold in 1903-4. There was an increase of only £39 in the working expenses over those of 1903-4. The expenditure on capital account stood at the close of the last financial year at £261,854.

Ormskirk.—On the 16th inst. the E.L. installation at the Workhouse was inaugurated. The sum borrowed for the work was £5,000, and this was reduced to £4,000 by the purchase of second-hand plant. The whole of the Workhouse premises have been wired, and at present over 700 electric lights are provided. The whole of the scheme has been carried out to the designs of Mr. G. R. Peers, of Manchester.

Pontypridd.—The South Wales Electrical Power Distribution Co. having publicly intimated that it is prepared to supply energy for domestic purposes in the town, the U.D.C., doubting whether the company has the legal right to do so, has decided to take counsel's opinion on the point.

Pwllheli.—The Town Council has been asked if it is willing for a small company to take over its E.L. prov. order.

Scarborough.—The local Electric Supply Corporation, in order to encourage the use of the electric light, has decided to fit up consumers' premises free of all initial cost, but to charge, in ordinary cases, a quarterly rental of 4½d. for each 8, 16, or 25-c.p. lamp installed. For energy through slot meters 7d. per unit will be charged.

South Perth (W.A.).—This residential suburb, situated on the south bank of the Swan River, has hitherto been without any public lighting system, but on May 19th a supply of electrical energy was commenced by the South Perth Electric Supply and Power Co., under agreement with the municipal authority. The boiler room plant consists of two B. & W. boilers, each of 460 sq. ft. heating surface, working at 160 lb. pressure; two Blake duplex feed pumps, and a feed-water heater capable of dealing with about 3,000 lb. of water per hour. In the engine room are at present installed two 25-kw. 460-volt Belliss-E.C.C. d.c. sets, and an E.C.C. balancer. The switchboard was constructed by the E.C.C., and is furnished with Everett, Edgcumbe moving-coil, edge-wise instruments, with vertical illuminated scales; each generator is protected by one of Dorman & Smith's reverse current circuit-breakers, and an integrating watt-hour-meter made by the Duncan Co. (Lafayette, U.S.A.) is installed for measuring the output of the station. The mains are of copper, braided and compounded, carried on Jarrah poles. The streets are lighted with 150 16-c.p. incandescent lamps; private consumers are supplied at 9d. per unit with discounts. The installation was supplied and erected by W. H. Kidston & Co., Murray Street, Perth.

South Shields.—A L.G.B. inquiry was held recently into an application by the Corporation for permission to borrow £15,625 for additional plant to enable a supply of energy to be given to the tramways which the Corporation is constructing, and also to supply energy to industrial concerns within the borough.

Stafford.—The Electricity Committee of the Corporation has paid a bonus representing about 5½ per cent. on their wages to the officers and workmen in the electricity department.

Tunbridge Wells.—Consumers have sent a memorial to the Corporation demanding a decrease in the price of energy, claiming that a large portion of the profit made last year should be for the benefit of those who pay for the light.

Wantage.—The Wantage Engineering Co. has decided to apply for a prov. order to supply the town with electric light. The U.D.C. has written to the County Council that it objects to the permission being granted, in the interest of the gasworks, owned by the municipality.

West Bromwich.—The fourth annual report on the Corporation electrical undertaking issued recently by Mr. J. H. Wray (Corporation electrical engineer) shows that during the year ending March 31st last 1,411,884 units were sold, an increase of 306,878 upon last year. There were increases of 184,773 units in the consumption for tramway purposes, of 59,377 by private consumers and 62,728 by public lamps. There are now 45 motors out on hire. The total cost per unit of electricity sold has been brought down to ·99d. The net profit for the year is £1,328, against £1,546 last year, a reduction of £218, which is accounted for by the fact that the revenue from traction has only increased by £545, although the output has increased by 184,773 units. An increase of £284 in rents, rates, &c., and the loss of over £187 on free wiring and motor hire has contributed to the reduction of this year's profits. The average revenue per unit sold is about 1·83d., and the percentage of total cost to revenue from sale of energy 88 per cent. The total capital expenditure to date is £61,024.

TRAMWAY AND RAILWAY NOTES.

Australia.—The first rail of the North Melbourne-Essendon-Flemington Electric Tramways was laid on 22nd inst. by the Premier of Victoria. This will be the first electric tramway in the Melbourne district. The work is being done by the Tramways Syndicate of London and Messrs. J. G. White & Co., Ltd., of London and New York.

Bradford.—The working of the tramways for the year ending March 31st has resulted in a total income of £230,085, or 10·927d. per car-mile, the mileage being 5,053,392. The previous year's income was £197,437, or 10·421d. per car-mile; the increase, therefore, during the past year has been ·506d. The department earned during the year, by the carriage of parcels, £1,840, and there was received for advertising rights on the cars £3,221—an increase of £430.

Brighton.—The accounts of the Corporation tramways for the year ended March 31st, show that the revenue amounted to £50,339, and the working expenses to £38,495, leaving a balance of £11,844. After meeting certain charges, however, the year's working showed a deficit of £321, the total deficit on the undertaking since its inception in 1901 being £4,016.

An interesting experiment is to be tried at Brighton in connection with the tramways. During July two "tourist cars" are to be run over the Corporation lines, the fare for a nine-mile run being fixed at 1s. A conductor, well versed in the places of interest *en route*, will describe the places passed.

Continental Notes.—Italy.—The project for the construction of an electric railway from the Italian-Ticino bank of Lake Maggiore to the Simplon Railway has been officially approved.

Austria.—Some trials have lately been made in Vienna with an electric motor-omnibus built by Messrs. Jacob Johner & Co., of that city, for service in Copenhagen. The vehicle has accommodation for 14 passengers, and about 11½ cwt. of luggage, and has the electric motors arranged in the hubs of the front road wheels. The 'bus, which runs on solid rubber tires, is intended for an average speed of 12 miles. The trials are stated to have given very satisfactory results.

Holland.—Plans are being prepared in respect of a projected electric tramway between Maestrict and Vaals.

Edinburgh.—The T.C. has approved the draft agreement with the promoters of the Queensferry Tramways, consenting to the proposed tramway from the boundary at Blackhall to the cable tramway terminus at Comely Bank, subject to conditions.

Great Yarmouth.—As the result of the working of the municipal tramways for the past year, the receipts were £8,736, while the expenses were £6,348, leaving a profit of £2,388, out of which £2,104 was paid for interest, sinking fund, &c., leaving a net balance of £284, increasing the balance in hand to £475. It was decided to place £400 to a depreciation fund, and to carry forward the remaining £75.

Glasgow.—At a meeting of the Tramways Committee of the T.C. a draft of the report and financial statement for the year ending May 31st, 1905, was submitted:—

Gross revenue		..£767,904
Expenditure:—		
Traffic	£217,873	
General	75,119	
Repairs	68,640	
Power	25,535	
	£387,167	
Set aside for renewal and depreciation	£153,334	
		£540,501
		£227,403
Lease of Govan lines	£5,080	
Rent of Paisley District Tramways	915	
Interest	49,906	
Sinking fund	46,920	
Income-tax	5,484	
Parliamentary expenses	891	
Common good	25,000	
		£134,146
		£93,257

The Committee proposes to appropriate £68,500 of this sum to special depreciation, and to carry the balance to reserve fund.

Heywood.—The T.C. has applied to the B. of T. for a loan of £37,200 for the construction of electric tramways.

Keighley.—The Tramways Committee has recommended the T.C. to apply to the B. of T. for a year's extension for the completion of the tramways.

Liverpool Overhead Railway Extension.—On and after Sunday next, through connection and bookings to and from all stations on the Liverpool Overhead and the Southport branch of the Lancashire and Yorkshire Railway will be possible. The fares on the Overhead have been revised, removing the objection that has frequently been raised to the universal rate for long or short distances. Thus, a person may travel between any two stations on the Overhead line for 2d. first and 1d. third class. On the other hand, those taking long-distance journeys will pay for the privilege.

London.—Royal Commission.—According to the *Standard*, the recommendations of the Commission which has considered the traffic of London for between two and three years will be bold and comprehensive. The keynote of the report will be easy transit and abundance of it. It will be thoroughly in favour of electric traction to be applied wherever it is needed, and in alternative forms to suit local needs. There will be no objection whatever made to over-bridge tramways. The tramway is to be universal as a method of transit, over an area of 200 square miles. Electric cars are to be advocated for thoroughfares like the Strand and Piccadilly. Streets are to be widened where necessary. Greater facility of movement will be recommended, and for this the police are to have larger powers. The whole traffic of the metropolis is to be incorporated under the regulations recommended. The recent agreement on the proposal to run the tramways over the bridges not only anticipates the recommendations of the Commission, but is thought by members of that body to render a Central Transit Board superfluous. In many significant instances the Commissioners are understood to have adopted the policy of the London County Council. The Commissioners have made such good progress with the report that the latter may be presented to Parliament on a very early day.

Metropolitan District Railways.—It is understood that to-morrow the long-expected inauguration of the electric service will take place. Four trains per hour will be run from Ealing, Acton and Hammersmith, to the City and Whitechapel. Several months will elapse before the conversion is complete, after which the tunnels will be cleaned.

We may add that elsewhere in this issue will be found the concluding section of our articles describing the electrical equipment of the railway and Lot's Road power station.

It is stated that following on the partial electrification of the the District Railway service, the Inner Circle service of the Metropolitan Railway will be worked by electricity next week.

Westminster.—Messrs. Baxter & Co. wrote to the City Council in regard to their claim for payment for the Charing Cross substation of the Underground Electric Railways Co. in Villiers Street, stating that the L.C.C. claimed the sub-soil. The Legal Committee of the City Council has decided that it must hold the company to their agreement, and that payment must be made in the same proportion as that paid to the L.C.C. for the use of the sub-soil of the Embankment Gardens. With regard to the proposed electrification by the L.C.C. of the tramways in Vauxhall Bridge Road, the City Council agrees to the same, subject to some minor matters being satisfactorily settled.

Fulham.—An intimation has been received by the B.C. from the L.C.C. that the proposed tramways along the Fulham Palace Road and High Street, Fulham, are to be constructed on the conduit system, similar to the lines in South London.

City.—On Thursday last week the Court of Common Council considered the Special Committee's report on the L.C.C. scheme for carrying the tramways over Blackfriars Bridge, and it was resolved that the Committee's report be adopted, with the addition of a proviso that the tramways may be laid over either the widened bridge or an entirely new bridge adjoining. Thus the City Corporation has at last abandoned its attitude of opposition to the County Council and to modern progress.

Manchester.—On Tuesday afternoon last the Tramways Committee of the Manchester Corporation had before it the annual report of the undertaking for the year ending March 31st, 1905. The aggregate length of single track open for traffic on that date was 146¼ miles, against 138 miles in the previous year.

The revenue account contains the following particulars, side by side with which those for the year 1903-4 are given for comparison:—

	1904-5.	1903-4.
Traffic revenue	£638,529 4 2	£603,182 6 1
Other revenue..	3,426 8 2	8,698 16 10
Total	631,955 12 4	611,881 3 8
Working expenses	411,597 3 11	391,853 13 11
Balance, being gross profit	220,358 8 5	220,027 9 9
Add bank interest	1,869 9 1	3,079 10 6
Leaving a sum available of	£222,227 17 6	£223,107 0 3

The charges which have been met out of this available surplus amount to £101,277, against £101,491 in the previous year, thus leaving a net profit of £120,950, against £121,705 in 1903-4, which has been appropriated as under:—

	1904-5.	1903-4.
Renewals and depreciation account	£70,907 0 0	£69,693 2 10
Contribution in aid of the rates	46,000 0 0	50,000 0 0
Street improvements round infirmary—interest, &c.	4,043 3 8	2,012 7 5
Total net profit	£120,950 3 8	£121,705 10 8

The contribution in aid of the rates this year falls short, according to the above table, by about £4,000 of the amount in the previous year. A footnote, however, states that this year's contribution has been increased by a sum of £5,000, which was transferred from a reserve fund accumulated in former years. This makes a total contribution in relief of the rates of £51,000.

The report also contains a summarised statement, giving statistical information regarding the working of the tramways for the past year, as follows:—

	1904-5.	1903-4.
Total borrowing powers	£1,925,000 0 0	£1,805,500 0 0
Borrowing powers exercised ..	1,515,168 0 0	1,505,668 0 0
Unexhausted borrowing powers ..	409,832 0 0	299,832 0 0
Gross capital expenditure	1,587,930 19 2	1,485,612 4 9

During the year the number of passengers carried was 126,900,875—an increase of over 6 millions on the previous year. The car-mileage shows an increase of considerably over 1,000 miles, the figures being 14,123,124 for the past year. The percentage of passengers' fares shows that 71·94 per cent. paid 1d. for the journey, 11·01 per cent. 1½d., 7·10 per cent. 2d., and 5·40 per cent. ½d.

Electrical energy used during last year amounted to 18,854,240 units, against 16,815,764 units for the previous year. The average traffic revenue per car-mile was 10·68d., against 10·52d., and the average traffic revenue per mile of single track was £4,299, against £4,468 in 1903-4. The average working expenses per car-mile, including power cost, were 6·99d. against 6·78d.

The amount of the sinking fund is now £60,987, against £27,224 in the previous year.

An accident, causing injury to three persons, occurred in Manchester on Sunday evening. A single-deck car, on the circular route from Cheetham Hill to Seymour Grove, was crossing Rochdale Road, at the junction of that thoroughfare with Queen's Road, when a heavily laden car proceeding townwards ran into it and knocked it clear of the metals.

The side of the single decker was stove in, and the controlling gear of the other car was forced out of position by the impact, and the ironwork twisted. The trolley arms of both vehicles were fortunately jerked clear of the wires, so that there was no breakage overhead. Two passengers in the smaller car received injuries, which necessitated their removal to the Infirmary. Those in the larger car were also more or less knocked about, and one was cut in the face by fragments of glass. Several suffered from nervous shock. The traffic was interrupted for two or three hours. The testimony of witnesses is that the cars were not travelling at an excessive speed, but the sun's heat had melted the pitch in the crevices of the stone paving, and this, getting upon the metals, had made them so slippery that the driver of the larger and heavier of the cars was unable to get his brake to act. A nice point, therefore, will arise when the compensation claims come to be disposed of.

Mansfield.—Trial trips are now being made over the Mansfield and District Light Railway Co.'s system which has just been put down.

Middlesex.—The County Council on the 22nd inst. approved of the payment of £7,762 to the county solicitor in order to pay compensation for land required for light railways. This sum makes the total authorised to be paid in respect of the purchase of property, &c., in connection with light railways by the 1901 order, £160,597, and under the 1903 order £58,347. Approval was given to a proposed arrangement between the Metropolitan Electric Tramways, Ltd., and the London County Council as regards the tramways in the Green Lanes and Seven Sisters Road. This agreement briefly was that in consideration of the Metropolitan Electric Tramways, Ltd., giving the L.C.C. possession of the tramways in the Seven Sisters Road, the L.C.C. will defer the purchase of the portions of the tramways in the Green Lanes and Seven Sisters Road, north and east of the Manor House and wholly in the County of London, until the year 1925, or possibly five years later, so as to make the tenure of these lines conterminous with the tenure of the portion of the tramways belonging to the company in Middlesex.

Newark.—The Light Railway Commissioners have submitted to the B. of T. for confirmation an order for the construction of light railways in the borough and in the rural district of Newark.

(*Continued on page* 1063.)

THE ELECTRIFICATION OF THE METROPOLITAN DISTRICT RAILWAY.

(*Concluded from page* 983.)

Of the 24 sub-stations through which the energy generated at Lot's Road will be distributed, some 15 will be primarily utilised for power distribution to the District Railway.

The equipment and general design of these sub-stations is fairly uniform, with the exception of those situated at Mansion House and Victoria, which are built over the railway, and that at Charing Cross, which is below ground level; the British Westinghouse Electric and Manufacturing Co., Ltd., were responsible for the supply and erection of all this plant.

The arrangement of a typical sub-station will be gathered from the elevation and plan, figs. 48 and 49; the 11,000-volt H.T. feeders, two or four in number according to the capacity of the plant installed, enter the sub-station on

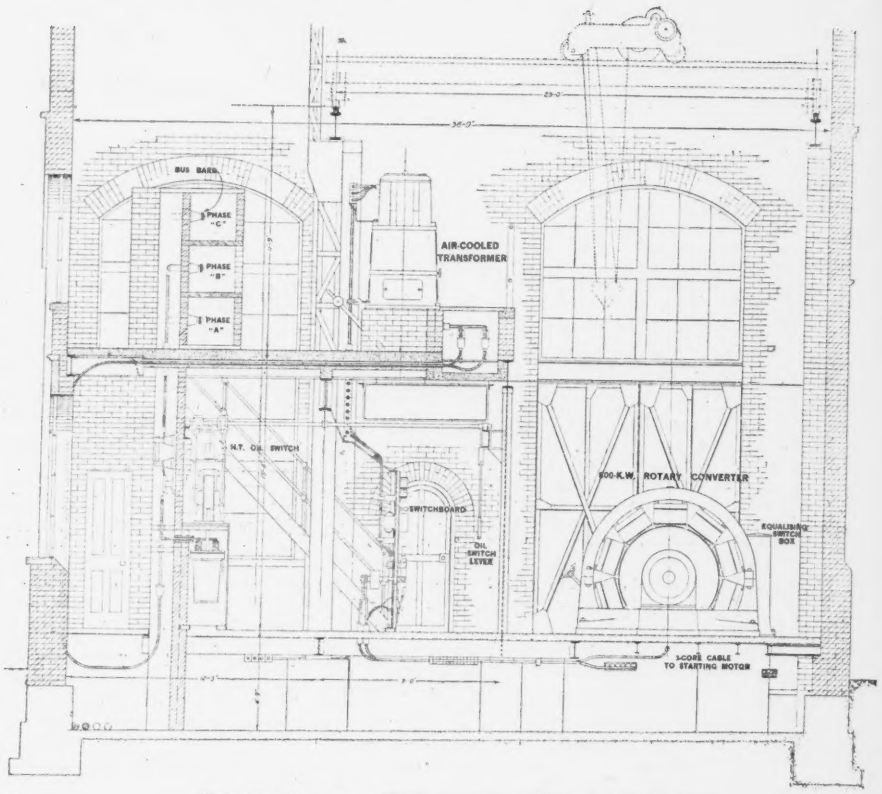

Fig. 48.—Sectional Elevation of a Typical Sub-Station.

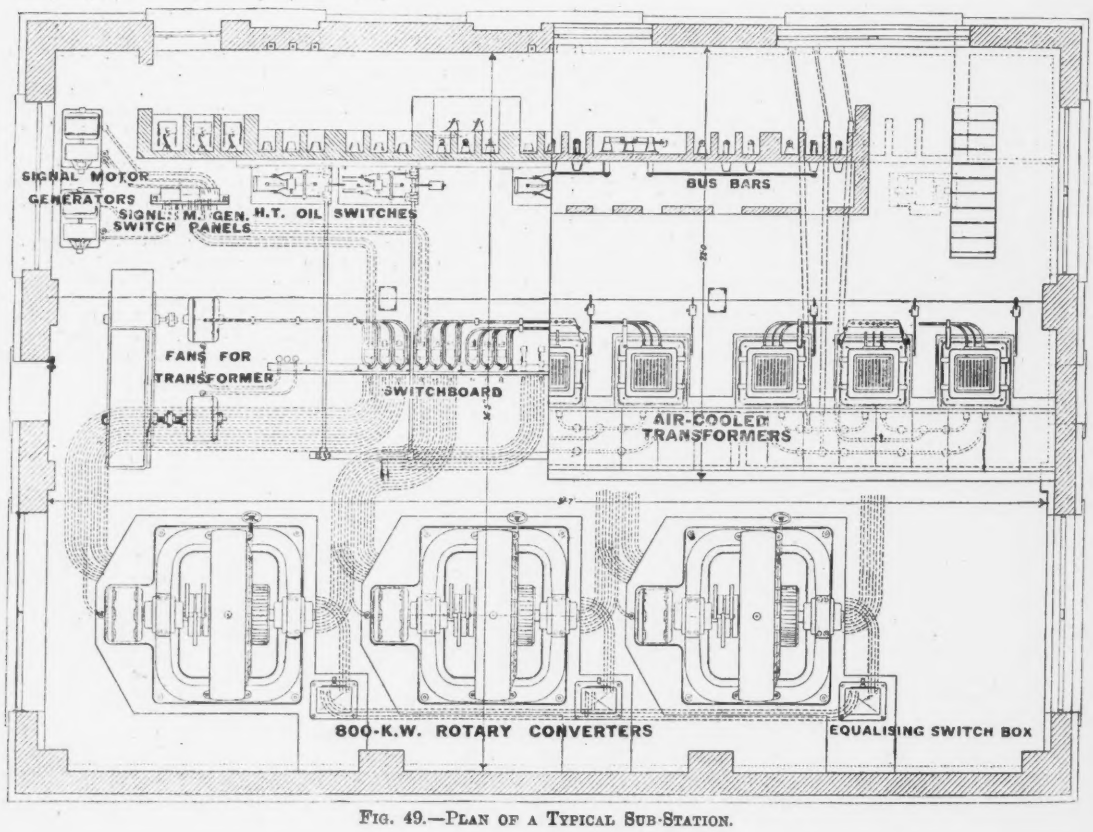

Fig. 49.—Plan of a Typical Sub-Station.

the basement floor level, and pass through a cast-iron dividing box; Westinghouse spark gap lightning arresters are installed for the protection of these feeders, which terminate in single knife pattern isolating switches.

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From the isolating switches the connection leads through feeder oil switches to the H.T. bars on the gallery. Reverse current relays are installed for the protection of the high tension feeders from the sub-station end, thus ensuring that short-circuit currents shall not flow to the feeders from the sub-station bus-bars.

The H.T. bus-bars are divided into sections by means of junction switches (fig. 56, p. 1062), each section having one feeder and one rotary converter connected to it. By the agency of selector switches of the same type and method of operation as the isolating switches, these bus-bar sections may be so connected as to use the feeders separately or in parallel as desired, and as similar selector switches are included in the rotary circuits, a very flexible and convenient arrangement is secured. The pressure transformers used in connection with the measuring instruments are also provided with selector switches, and thus may be fed from any particular pair of bus-bars, if necessary.

The circuits to the primaries of the step-down transformers are completed through isolating and main oil switches in series, the secondaries being connected to the collector rings of the rotaries through sets of three single-pole knife switches. The main oil switch of each converter is in the ordinary way hand-operated, but it is also fitted with an overload time-limit relay, which comes into operation, automatically tripping the switch if a prolonged short-circuit or overload occurs. In addition, there is a push-button on the switchboard, the pressing of which will electrically open the main switch.

Two knife switches, one for each pole, are provided for the D.C. side of the rotary converter, and there is also a reverse current circuit-breaker in the negative side, and the usual equalising switch placed on a cast-iron pillar close to the machine.

The Earl's Court sub-station, of which a series of illustrations is given in the present article, will ultimately contain four 1,500-KW. rotary converters, each coupled to an induction motor, the latter being used for starting purposes.

The rotaries are of massive construction, and the leading particulars of the three sizes utilised on the railway are as follows:—

Size...	800 KW.	1,200 KW.	1,500 KW.
Number of poles	10	12	16
Speed, r.p.m.	400	333	250
Efficiency, 1¼ load ...	95·3	96·2	96·25
" full " ...	95·0	95·7	96·00
" ¾ " ...	94·3	95·0	95·25
" ½ " ...	92·3	93·5	94·00

The fields are compound-wound, the series and shunt windings being divided by air spaces; the pole-pieces are provided with copper shields consisting of heavy copper rings round the pole tips, with lips extending inwards.

The machines are guaranteed to stand an overload of not less than three times the normal full load without falling out of step, and to run sparklessly without brush adjustment up to 50 per cent. overload.

Figs. 50 and 54 illustrate the 1,500-KW. rotaries installed at Earl's Court.

The transformers, which are mounted on the gallery (fig. 51, p. 1060), are of the vertical air-cooled type, with the primary and secondary coils wound and insulated in sections.

The transformation ratio is adjustable for the purpose of equalising the pressure of the current delivered to the rotaries in the various sub-stations. Three transformers, delta-connected on both the primary and secondary sides, and a rotary constitute a unit for operating purposes.

Three sizes of power transformer are installed—viz., 300 KW., 435 KW., and 550 KW.—according to the size of the rotary; and for the station and tunnel lighting, wherever necessary, two single-phase 150-KW. lighting transformers, having a ratio of 11,000 to 220 volts, are also installed.

These latter transformers are "V" connected, with a view to equalising the load on the primary side, the connection being made to the centre of one of the H.T. bus-junction switches.

The transformers stand on iron bases, and regulating dampers are provided both in the base and top of each trans-

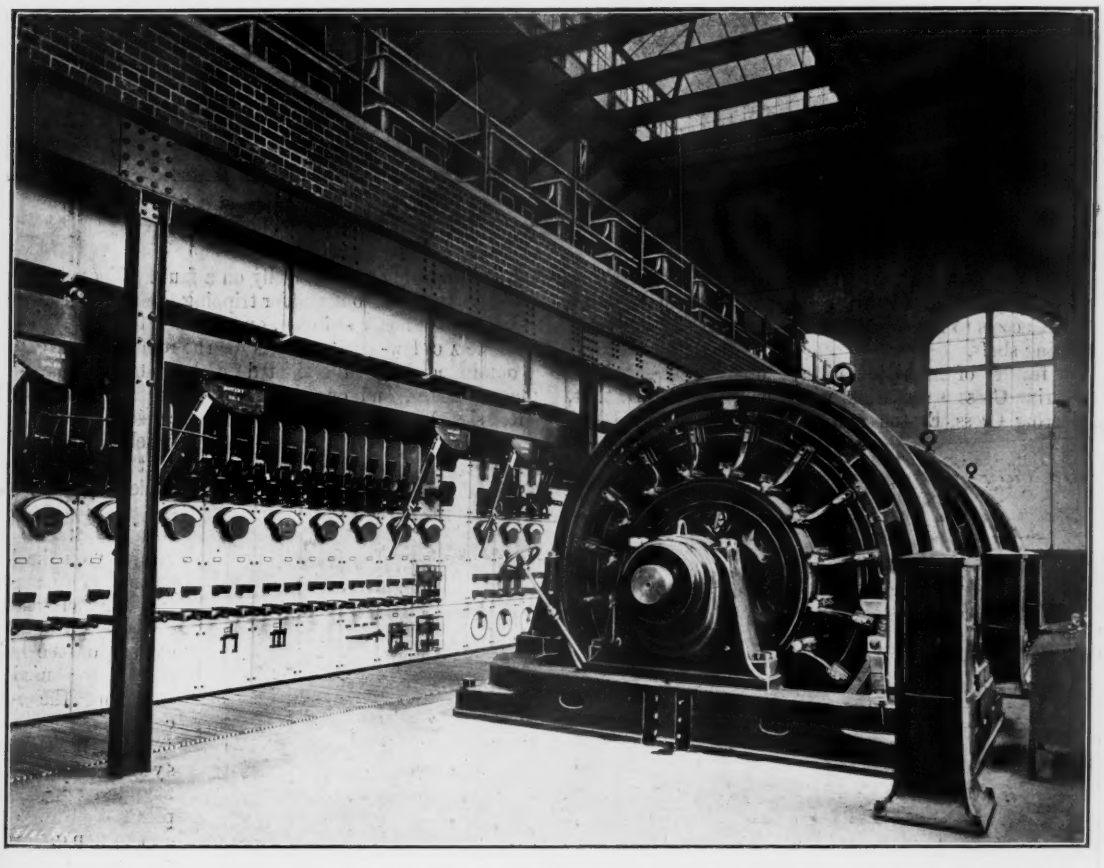


FIG. 50.—VIEW OF INTERIOR OF EARL'S COURT SUB-STATION.

former for adjusting the air blast, which is supplied by duplicate ventilating fans, each coupled direct to a constant speed induction motor, these sets being installed in each sub-station.

The fan motors are connected to different power transformer units so as to ensure that one fan at least shall always be available.

In addition to the above, each sub-station contains signal equipment. Fig. 55 (p. 1062) illustrates the motor-driven Christensen air compressors installed at Earl's Court, the automatic air controllers, which operate when a fall in pressure occurs in the signal-pipe line, being mounted on the wall above.

Duplicate signal motor-generator sets, each consisting of an 8-KW. 365-volt three-phase induction motor coupled to a 70-volt compound-wound D.C. generator, are also provided for supplying energy to the electrical signal circuits.

These motor-generators are each fed from an independent power transformer unit, and are provided with a separate two-panel switchboard. A 12-ton hand travelling crane is provided in the larger sub-stations, and similar 8-ton cranes in the smaller ones.

One of our illustrations, fig. 52, shows the Earl's Court switchboard, which, it may be mentioned, is also equipped for supplying the Great Northern, Piccadilly and Brompton Tube Railway, which at this point runs beneath the District line, access to it being obtained by means of a cable and ventilating shaft.

This feature of multiple railway supply also occurs at the Charing Cross sub-station, which will feed the District, the Charing Cross, Euston and Hampstead, and the Baker Street and Waterloo Railways; a ventilation and cable shaft is provided here also, to the tube line beneath.

The switchgear is of uniform character throughout the various sub-stations, and is mounted on blue Vermont marble panels, varying in number from 14 to 33, according to the character of the supply.

The incoming high-tension feeders are connected, two each, to two instrument panels, each fitted with ammeters, two synchroscopes, two integrating wattmeters, and two polyphase reverse current relays. Two red signal lamps, below the ammeters, are so connected with the two main feeder switches that they will light up in the event of either of these opening automatically on a fault. These panels also contain two push buttons for tripping the main oil switches, and two voltmeter switches, one for each feeder.

FIG. 51.—AIR COOLED TRANSFORMERS, EARL'S COURT.

The A.C. low-tension panels for the rotary converters each contain a large illuminated dial ammeter, one power factor meter, and one polyphase overload time-limit relay. Red signal lamps are also fitted, as in the case of the H.T. feeder panels. The A.C. side of the rotary is controlled by three large single-pole knife switches placed conveniently on the lower portion of the panel, and the sub-base of each contains a starting switch for the induction motor used for starting the rotary converters.

A Westinghouse synchroscope is mounted over these panels.

The D.C. rotary panels each contain a circuit-breaker with a reverse current relay attachment, an illuminated dial ammeter, two single-pole knife switches, and on the sub-base a rheostat dial switch.

A main load panel, containing an illuminated dial voltmeter for the bus-bars and another similar one for the machines, an illuminated dial ammeter for measuring the total bus-bar current, and a watt-hour-meter panel for metering the power supplied to the lines, is also provided.

The train section and track feeder panels are each equipped with two single-pole circuit-breakers, one illuminated dial ammeter, and two single-pole knife switches; this double-pole arrangement is necessary, as both the posi-

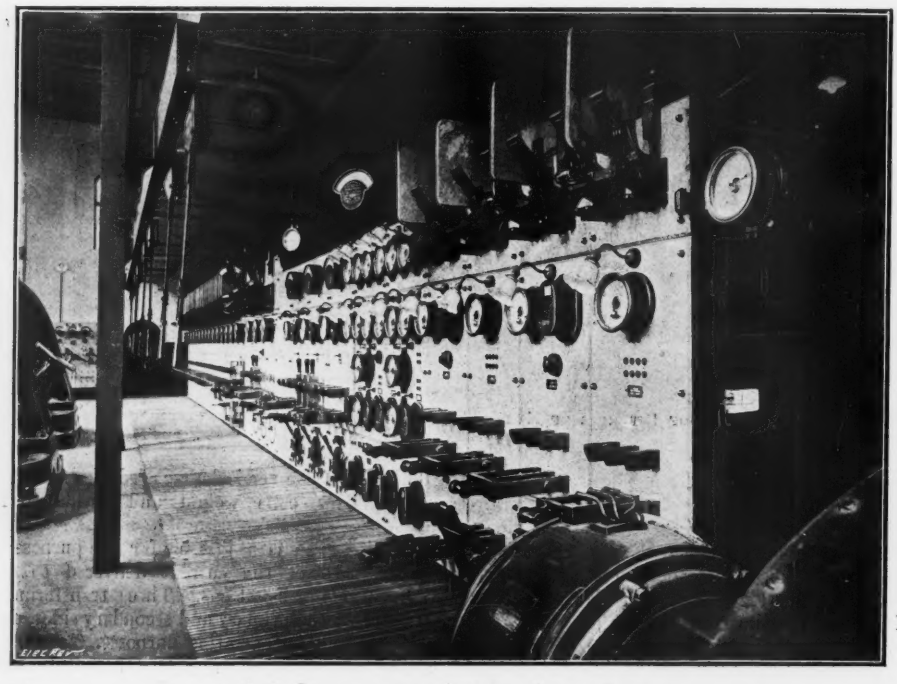


FIG. 52.—VIEW OF THE SWITCHBOARD, EARL'S COURT.

tive and negative conductor rails are insulated from earth throughout.

The panels for controlling the lighting circuits are each provided with double-pole circuit breakers, ammeters and integrating wattmeters; these panels are fed from the main switchboard through a triple-pole automatic oil-switch, and a triple-pole main switch is provided for disconnecting the lighting transformers on the secondary side.

The bus-bars, which are built up of 6-in. × ¼-in. copper strip, are arranged with a ventilating space between successive sections instead of being clamped together solid, as is frequently done.

The low tension A.C. ammeters are all operated by small series transformers, which, in themselves, are decidedly unique. They consist only of a magnetic circuit and secondary winding, and all that is necessary is to slip them over the switch studs, which form the primary, inducing, by virtue of the current flowing in them, the secondary current that operates the instrument.

The whole of the high tension gear, such as cable ends, series transformer, &c., is isolated in brick cells; in similar, but horizontal cells, the high tension bus-bars are placed, and the lightning arresters have each a separate cubicle with a fireproof door completely isolating them, but rendering access easy.

Hand operation is used for all the oil-break switches in the sub-stations, and this is effected through gearing by stout levers. These switches and the rear of the switchboard panels at Earl's Court are shown in figs. 53 and 57; the switches are of Westinghouse standard type, and are erected in a masonry structure, with each pole, and the oil tank in which they are immersed, in a separate fireproof compartment; their construction is similar to that of those used on the N.E. Railway (see ELECTRICAL REVIEW, September 9th, 1904), except that the latter are electrically operated; they were also described in connection with the electrification of the Metropolitan Railway.

The cable work in connection with the District and associated lines has naturally been of a very extensive character, and has, moreover, been carried out under exceptional conditions.

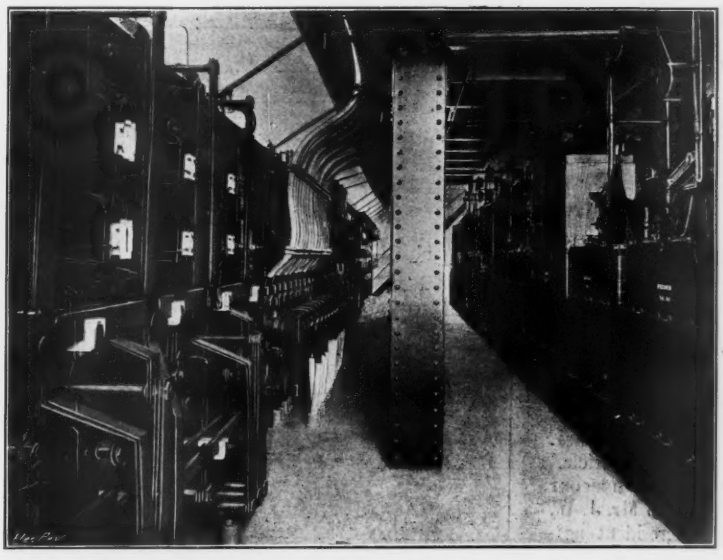


FIG. 53.—VIEW BEHIND EARL'S COURT SWITCHBOARD, SHOWING H.T. OIL SWITCHGEAR.

As previously stated, the 11,000-volt H.T. feeder cables from Lot's Road enter the District Railway at Earl's Court, and follow the track to the various sub-stations; feeder connections are made to the several tube railways through the District sub-stations situated over the latter, as at Earl's Court and Charing Cross. For all purposes the District Railway accommodates some 285 miles of H.T. feeder cables, including the cable connections to Lot's Road.

These cables are of the paper-insulated lead-covered three-core type, contracts for the supply and laying of which were placed with the British Insulated and Helsby Cables, Callender's Cable and Construction Co., W. T. Henley's Telegraph Works Co., the Western Electric Co. and the Electrical Co.; the cables were subjected to a factory test of 33,000 volts, and a further 22,000-volt test after laying and jointing.

The installing of the cables was confined to 2½ hours during six week nights and 4½ hours on Saturday nights, the procedure being to pay out the cable from a slowly-moving train, at the same time inserting it in the correct trough. In this way from three to five drums were installed per hour. The operating problems connected with the District Railway do not come within the scope of this article; these are at the present time receiving attention at the capable

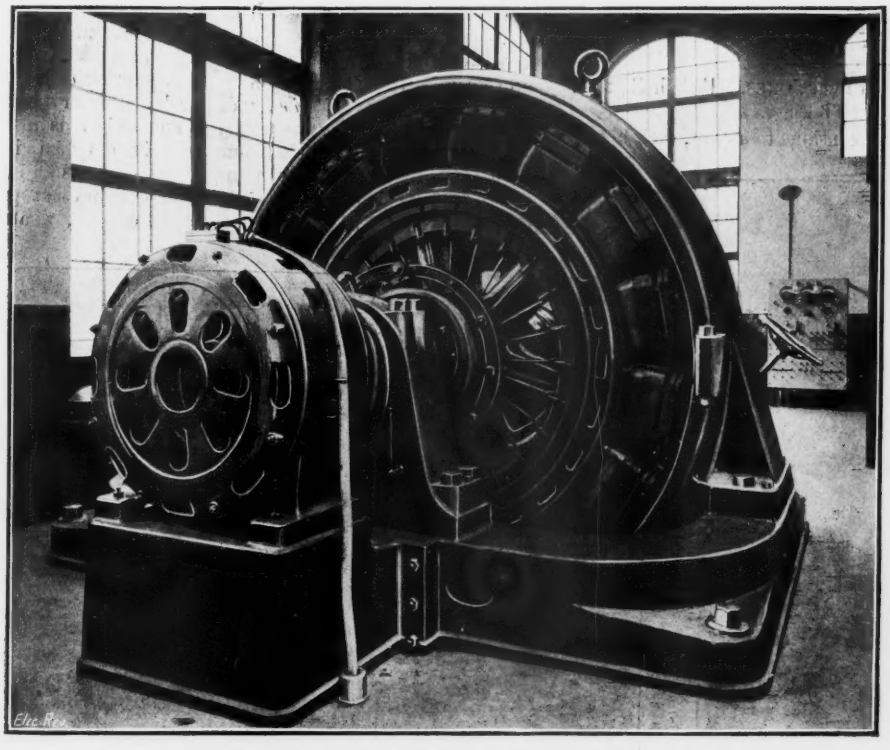


FIG. 54.—WESTINGHOUSE 1,500-KW. 3-PHASE ROTARY CONVERTER.

hands of Mr. John Young, the recently appointed general manager, and the electrical train service, at present restricted to certain sections of the line, will be gradually extended over the whole system.

In conclusion, we wish to acknowledge our indebtedness to Mr. J. R. Chapman, the general manager and chief engineer to the Underground Electric Railways Co. of London—under whose direction the Chelsea power station and the whole of the work entailed in the electrification of the District Railway and of the associated tube railways has been carried out—for the facilities which he kindly placed at our disposal for the preparation of this article.

We also tender our thanks to Mr. J. W. Towle, resident engineer at the power station; Mr. S. B. Fortenbaugh, electrical engineer to the Underground Railways Co.; Mr. W. E. Hanson, of the permanent way department; and to Mr. F. D. Ward, whose headquarters are at Mill Hill Park.

To the British Westinghouse and British Thomson-Houston Companies we are also indebted for much valuable information.

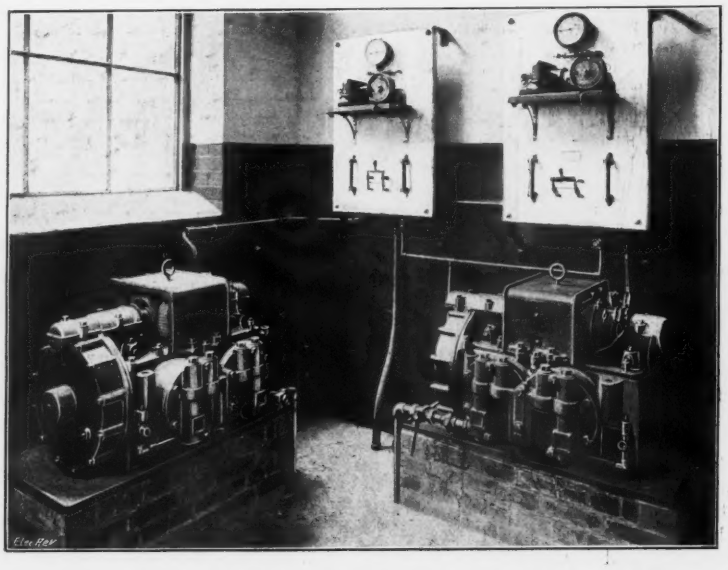


Fig. 55.—Signal Air Compressors, Earl's Court.

REVIEWS.

Medical Electricity. By Dr. Lewis Jones. Fourth Edition. London: Lewis. Price 12s. 6d. net.

New editions of this book continue to appear, each bigger and better than the last. To have reached a fourth edition is a very respectable achievement for a work that must of necessity appeal to a very limited number of readers. About a dozen years ago it appeared as a comparatively diminutive hand-book; this fourth edition forms a demy octavo volume of over 500 pages. Its increased bulk is due chiefly to what may be called the *indirect* curative applications of electricity, such as light and X-rays. High frequency currents, which in former editions had been dismissed with rather short notice, here get a chapter to themselves. This portion of the book seems to bring out the fact that for his more modern work the author draws his inspiration largely from French sources; indeed, in his preface he very properly acknowledges this.

As in all previous editions, the book contains an exposition of the elementary facts and principles of electrical science. It may be a question whether there is now the same need as formerly for such information, inasmuch as the course of studies preliminary to the actual medical curriculum now places the student of therapeutic electricity in a better position than when the first edition of this book was projected. It is possible that the further knowledge required might be better derived from the standard electrical text-books. One advantage at least would thus be secured, viz., that a greater amount of space would be available for the special matter in hand.

In a book covering so much ground, there must be many points with which the reader does not find himself in perfect agreement, and there are certainly some that seem scarcely up to date. Thus, speaking of what the author calls "Mechanical Interrupters," *i.e.*, "dipper" and rotary breaks, we read that the movement of the mechanism is usually effected by "a small electro-motor driven by an independent battery." But who nowadays constructs an interrupter needing a separate supply? Surely present practice provides for a shunt off the coil current, whatever that may be, whether from batteries or supply mains. A perusal of this portion of the book will probably leave on the mind of the reader an impression that the "dipper" break receives a rather scant measure of justice. A description is given of the McKenzie Davidson break with the

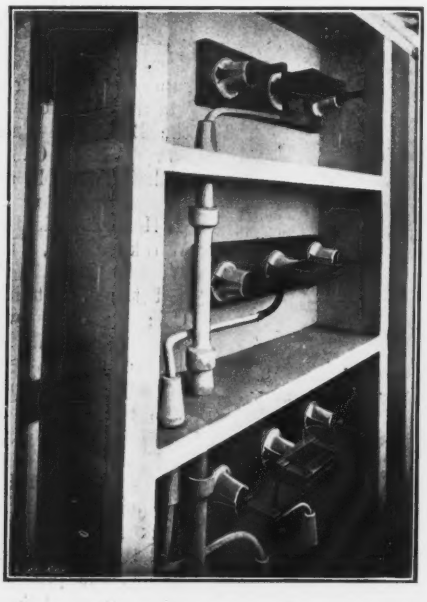


Fig. 56.—Bus-bar Section Switches.

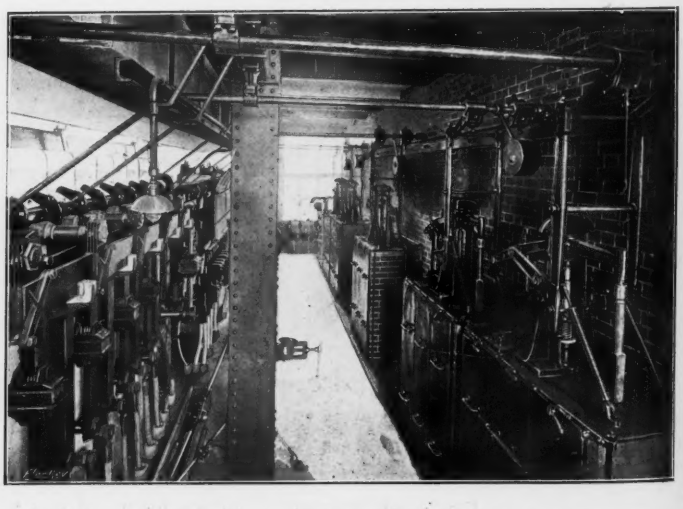


Fig. 57.—View of Westinghouse Hand-operated H.T. Oil Switches.

assurance that "it acts very efficiently." In the opinion of some it might be correct to add that this efficiency applies chiefly to high speeds. At low speeds the fact of this break not leaving the mercury vertically, but leaving it, as it does, with a centrifugal movement, prolongs the period of break, thus giving the self-induction of the coil time to become active, and resulting in heavy disturbances in the mercury container. With reference to another class of high speed interrupter known as the "turbine," it might have been stated that difficulties not unfrequently occur due to the "emulsified" mercury blocking the jets. On the other hand, if operated at a moderate speed, it has sometimes been found that the pump does not gather sufficient centrifugal force to project the mercury from the jets in a continuous stream, thereby giving rise to imperfect interruptions which are very undesirable. A little further on, in describing the Contremoullin-Gaiffe interrupter, it is stated that "mercury is used" to amalgamate the moving surfaces. So far as the present writer is aware, this description cannot apply correctly to the break named, as this break does not use an amalgam of mercury. It would hold good of the "Gleitkontackt" of the interrupter of Herschman, of Berlin. At p. 88, speaking of the management of the Wehnelt interrupter, it is stated that "the contact-breaker proper of the coil must be screwed down." But surely the platinum interrupter is another vestige of 19th century practice, and can scarcely need mention in connection with modern construction.

It would not be difficult to continue the enumeration of similar instances; but let it be remembered that it is much more easy to pen criticisms on such points than to write a book, whose aim it is to encompass in 500 pages the whole ground of therapeutic electricity.

Design and Construction of Modern Electrical Machinery. By Ernst Schulz. Hanover: Jänecke Bros. Price M. 7.50.

In this little work, which is in German, the author deals with the design of small dynamos and motors, both for direct and alternating current, from not merely a scientific, but also a commercial, point of view.

The author indicates the lines which should be followed with a view to obtaining the maximum output from a given weight of material, to arranging the designs suitably for manufacture in quantity, and to laying out ranges of machines, each carcass of which can be wound in a number of different ways.

The author first deals with the determination of diameter and length of armature and number of poles with a view to choosing such proportions as will keep the reactance voltage within specified limits. One chapter is devoted to the various formulæ for reactance voltage. The most suitable materials and shapes for magnets, pole-pieces and yokes are considered, also suitable designs of armatures and other parts for manufacture in quantities, and examples are given of the design of ranges of machines. The section relating to direct-current concludes with a chapter on prime cost.

In the second section the author treats the design of small polyphase motors on the same general lines, the leakage factor receiving in this case the same consideration as was given to reactance voltage when dealing with direct-current machines. The concluding portion of the work contains photographic views, sections and particulars of windings, &c., of a number of small machines by various Continental makers.

Among the most novel is a range of machines by the Gesellschaft für Elektrische Industrie, Karlsruhe, which are fitted with ball bearings. The author states that this firm fits ball bearings on machines up to about 20 H.P. He does not give us any information as to the saving in running expense effected by these bearings, but recently in the *Teknisk Ugeblad* some experimental data respecting this firm's machines fitted with ball bearings were given, and from these data it would appear to be worth the while of English makers to give the matter their attention.

In conclusion, we may say that this is a useful little book, but being in German its field of utility in this country will be somewhat circumscribed.

TRAMWAY AND RAILWAY NOTES.

(*Concluded from page* 1057.)

Oxford.—At a special meeting of the T.C. on June 21st resolutions were passed deciding to purchase the undertaking of the Oxford and District Tramways Co. The Council proposes to convert the system to electric traction. Already offers to purchase the undertaking from the Council have been received.

Perth (W.A.).—The returns of the tramways for 1904 show gross receipts amounting to £69,411, and a profit of £29,360, as compared with £62,524 and £22,912 in 1903. After paying interest on debentures, sinking fund, &c., the balance amounts to £14,181, making, with the balance brought forward and interest on guarantee deposit, a total of £17,913. From this is deducted £9,000 for preference dividends, including arrears to date, and £450 tax, leaving a balance of £8,463, of which £5,000 is to be paid to reserve and the rest carried forward. The length of track owned by the company is now 22 miles, and during the year the cars travelled 981,616 car-miles, carrying 6,924,619 passengers. The receipts per car-mile were 16·90d., and the expenses 8·68d., the ratio being 51·37 per cent., as compared with 56 per cent. in 1903.

Rhondda.—On June 15th a B. of T. inquiry was held into the proposal by the U.D.C. to lease the proposed electric tramways to a company which it is intended to form. The line to be leased is that from Hafod to Treherbert and Mardy. The syndicate, under the prospective agreement, undertakes to pay the Council £2,250 per annum, and at the end of forty-two years the Council could buy the undertaking with the sinking fund established out of the rental, which at 3½ per cent. would amount to £208,305. The line will be 26 miles in length, and the total estimated cost is £222,268. There was opposition on behalf of a number of ratepayers and the Taff Vale Railway Co., it being argued that the undertaking would not be a financial success.

Southend.—The T.C. has decided not to consider the question of extending the electric tramways to Shoeburyness unless the foreshore is assigned to the Council.

South Shields.—On the 20th inst. Mr. M. K. North, L.G.B. inspector, held an inquiry at South Shields with respect to the application of the South Shields Corporation for power to borrow £15,625 for the purpose of carrying out certain extensions at the electricity works to meet the requirements of the electric tramway service. These consist of two 550-kw. sets, and the necessary auxiliaries. The estimated cost of the engineering work was £14,425, and there would be in addition architectural work to cost £1,200. It was calculated that such portion of the tramways as the Corporation proposed to construct within the next year or two would require about 300 kw. Mr. J. H. Cawthra, borough electrical engineer, gave evidence, and said there would be about 6½ miles of tramways to supply.

Sunderland.—In the annual report of the general manager of the Corporation Tramways, Mr. A. R. Dayson, it is stated that by taking advantage of the increase of speed granted by the B. of T., it has been possible to take a car off each of three routes and yet maintain the same time service. The gross profits for the year were £24,747, as compared with £26,748 in the previous year. The gross revenue was £64,446; of this, traffic revenue accounted for £64,203. The total working expenses were £39,698, and there was a balance carried to net revenue account of £24,747. The principal items of expenditure were:—Wages (traffic department), £12,713; cleaning and oiling cars, £2,055; ticket check (including wages of inspectors and clerks), £1,118. The total traffic expenses were £17,647, representing 2·83d. per car-mile. General expenses totalled £5,112, or 0·82d. per car-mile; half of this sum was represented by rates and taxes. General repairs and maintenance account for £3,602, or 0·579d. per car mile. Energy cost £13,338, being charged at the rate of 1⅞d. per unit; this represented 2·141d. per car-mile. This makes total working expenses 6·37d. per car-mile, as against an income of 10·34d., leaving a balance to net revenue account of 3·97d. This net revenue was disposed of as follows:—Interest on capital, £9,357; income-tax on profits (two years), £1,097; repayment of loans, £8,971; reserve and renewals funds, £5,247; compensation reserve fund, £489. There is no balance to hand over to the relief of the rates. The total capital expenditure now stands at £285,756, of which £8,516 was incurred this year, and loans redeemed total £34,181.

United States.—Columbus, Ohio.—A new company with a capital of £4,000,000 has been formed to lease, own and operate electric street-car lines between Cincinnati and Hamilton. The money comes mainly from Mr. P. A. B. Widener and Mr. George W. Wilkins, of Philadelphia, Pa., who are both largely identified with electric tramway enterprises.

New York City.—Statistics show that the subway during the first quarter of 1905 took away an average of 214,000 passengers a day from the surface and elevated lines, besides drawing an additional daily total of 114,000 passengers who never rode before. The total passenger traffic is now within one-fifth of the official estimated capacity. With the approach of the hot weather, it is found that at times the atmosphere in the subway is extremely and unpleasantly humid. On June 12th a short new section of the tunnel was opened for traffic, and by July 1st it is promised that the entire system shall be in operation. The authorities have authorised plans for three new subways north and south, but have thrown out

plans for a moving platform across town. Mr. Paul Morton, late secretary of the U.S. Naval Department, came to New York recently, ostensibly to take over the management of the Metropolitan Street Railway system, which controls all the surface lines, and a hard struggle was looked for between the Metropolitan and the subway interests in the matter of new subways; but in the meantime Mr. Morton has been elected president of the Equitable Life Assurance Society, with the control of assets valued on paper at £160,000,000, and his election has been warmly endorsed by Mr. August Belmont, of the subway company, and Mr. T. F. Ryan, of the Metropolitan. It looks as if the recent advance of municipal ownership ideas has forced these two rivals into each other's arms, and their financial control of the assets of the Equitable Society will aid them in developing their traction plans. The Supreme Court of the United States has decided in favour of the validity of the New York State law imposing a tax on franchises, and this means that in the City of New York the local traction, lighting and other companies will be called upon to pay arrears of franchise taxes amounting to nearly £5,000,000. The New York State Legislature has also taken away from the city aldermen the right to grant future franchises; and in view of the promised litigation to test the constitutionality of this law, all pending plans will be held over indefinitely, including the new enterprises mentioned above.

Warrington.—Col. Von Donop, of the Board of Trade, on the 23rd inst. inspected the tramway extension at Stockton Heath, Warrington. The work of crossing the bridge, which spans the Ship Canal, was one of great difficulty, but has been successfully overcome. The extension has cost the Corporation about £10,000, and an extra charge of ½d. will be made for the ride.

TELEGRAPH AND TELEPHONE NOTES.

The Iceland Cable.—In his report upon the Faröe Islands for 1904, Mr. Consul Villiers refers to the fact that the telegraphic cable from the Shetland Islands to Faröe and Iceland will be opened for public service on October 1st, 1906, which prospect he dwells upon at some length, it being of the greatest importance to the British fishing industries that their vessels should not be entirely isolated, especially in case of wreck or breakdown. The contract with the Great Northern Telegraph Co. is for 20 years from its opening, and the company will receive an annual subsidy of 54,000 kr. (£3,000) from Denmark, and 35,000 kr. (£1,944) from Iceland. Land has been secured in Thorshavn for the company. The cable will not be laid to the capital but to the east coast, where it must be served by land lines to be of practical use. The establishment of telegraphic communication will have far-reaching consequences beyond the obvious ones, such as naturally result from means of intercommunication being established in a place where, a year or so ago, months passed without any news being received from the outside world. Prices will be quoted and vessels will know when and where to go to sell fish. In future, whenever the weather permits of fishing, the fact can be telegraphed to the United Kingdom, and a steamer be sent to the designated place. It will also enable many people to visit the islands who would hitherto have hesitated to do so when it involved complete isolation from all news.

Lightships and Wireless Telegraphy.—The B. of T. and Trinity House have concluded a contract with Marconi's Wireless Telegraph Co., Ltd., for the equipment of lightships with Marconi installations. Lightships will thus be able freely to communicate with the shore and with one another for all purposes of the service.

Telegraph Conference.—During the week the conference between representatives of the Colonies and of the British Government was held at the Colonial Office. The proceedings were private, but it is reported that a sub-committee has been appointed to ascertain whether it is possible to come to a working arrangement with the Eastern Telegraph Company.

Telegraph Regulations.—The Postmaster-General gives notice in the *London Gazette* that the rules specified in Regulation 24 have been varied by him as follows:—(1) With reference to the names of places—paragraph 1 (*b*) of the said Regulations—the name of a town or village and of a county in the address of a telegram will be counted as one word when the addition of the name of the county is necessary to distinguish the town or village from some other place of the same name. Thus the words Sutton (Cambs.) and Sutton (Yorks.) will in each case be counted as one word. (2) With reference to combinations of figures and letters—paragraph 1 (*k*) of the said Regulation—a combination of figures and letters in the address of a telegram, when denoting the number of a house, will be counted as though the letters were figures. Thus 104 A, A 5 will be counted as four figures and two figures respectively—*i.e.*, as one word in each case.

Telephone Extension.—In the Parliamentary papers of Wednesday, Colonel Stopford Sackville asked the Postmaster-General whether any extension of the telephone system is now being carried on within the county of Northampton. Lord Stanley, in reply, stated that exchanges had been opened during the present year at Daventry and Brackley, and an exchange is in course of construction at Towcester. Estimates are in preparation for exchanges at Oundle and Thrapston, and the establishment of exchanges at these towns will depend upon the amount of support which is forthcoming.

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Dakar-Conakry	May 11, 1905	June 7
Paramaribo-Cayenne	May 25, 1905	
Bolama-Bissao	June 21, 1905	
St. Jacques-Haiphong	June 26, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	

CONTRACTS OPEN AND CLOSED

OPEN.

Ayr.—Electric lighting works at the Court House. Schedules of measurement on payment of 10s. from Allan Stevenson, 14, Cathcart Street, Ayr.

Bradford.—July 3rd. Tenders are invited for the lighting of Block "A" of the Grange Road New Council Schools by electricity. Plans and particulars, Messrs. T. C. Hope & Sons, Bank Street, Bradford.

Bradford.—July 3rd. The Corporation invites tenders for electric lighting installation in connection with the alterations at the Central Public Library, Darley Street. Drawings, &c., on application to the City Architect, Whitaker Buildings, Brewery Street.

Brighton.—July 3rd. Coal-handling equipment and a 260-cell storage battery for the Southwick power station. See two "Official Notices" June 23rd.

Burton-upon-Trent.—July 7th. Overhead equipment of 1¾ miles of tramways. See "Official Notices" June 23rd.

Caerphilly.—July 24th. Cables, kiosks, transformers, switchgear, lamp pillars for the U.D.C. See "Official Notices" to-day.

Dewsbury.—July 5th. Electric wiring and fitting for the Dewsbury Pioneers Industrial Society's warehouse in Wellington Road. Messrs. Holton & Fox, architects, Corporation Street.

Fulham.—July 12th. Extension of cables, feeders, &c. See "Official Notices" June 23rd.

Germany.—The municipal authorities of Villingen are about to invite tenders for the establishment of a central electric lighting station in the town at an estimated cost of £10,700.

Glasgow.—July 3rd. The Corporation invites tenders for steel and cast-iron water pipes of 30-in. and 36-in. bore, with fittings. Particulars from Mr. W. W. Lackie, 75, Waterloo Street, Glasgow, on payment of a deposit of two guineas.

Hamilton.—July 15th. The Corporation invites offers for the construction and working of electric tramways. See "Official Notices" June 23rd.

Hornsey.—July 3rd. Electric light installation at the Council's Crouch End School. See "Official Notices" June 23rd.

Ilford.—July 11th. Cable for the U.D.C. See "Official Notices" to-day.

Kilkenny.—The Corporation will entertain offers from those willing to provide electric lighting. The population is about 10,500, and water power is plentiful. Mr. R. J. Gore, Town Hall.

Leigh.—July 1st. One water-tube boiler. See "Official Notices" June 9th.

London.—July 11th. Two low-tension feeder switchboards for L.C.C. tramways sub-stations. See "Official Notices" June 23rd.

L.C.C.—July 11th. Four sets of switchgear for tramway sub-stations at Battersea, Clapham, Streatham and Wandsworth. See "Official Notices" June 23rd.

Loughborough.—July 18th. Stores, &c., for the electricity department. See "Official Notices" to-day.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Neath.—July 17th. Mains, sub-stations, switchboards, feeder and switch pillars, excavations, &c., for the U.D.C. electric lighting scheme. See "Official Notices" to-day.

Newport (Mon.).—July 8th. Piping, cooling tower, and condenser, for the Electricity Committee.—See "Official Notices" June 23rd.

Rotherham.—July 8th. Tramway department stores and materials for one year. See "Official Notices" to-day.

Salford.—July 10th. Fuel for the electricity works for one year. See "Official Notices" to-day.

Shoreditch.—July 18th. Two 1,500-KW. steam turbo-generators, condensers, pumps, piping, &c. See "Official Notices" June 23rd.

Spain.—July 3rd. The municipal authorities of Fregenal are inviting tenders until July 3rd for the concession for the electric lighting of the town during a period of ten years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Fregenal.

Spain.—July 4th. The Spanish Post and Telegraph authorities in Madrid are inviting tenders until July 4th for the concession for the establishment and working of a telephone exchange in the town of Talavera de la Reina (province of Toledo). Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas 10, Madrid.

Spain.—July 5th. The municipal authorities of Mazarron are inviting tenders for the concession for the electric lighting of the town during a period of 30 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Mazarron.

Weymouth and Melcombe Regis.—July 14th. Stores and coal for the electricity department. See two "Official Notices" June 23rd.

Wishaw.—July 11th. Mains, roadwork, and street arc lamps. See "Official Notices" to-day.

CLOSED.

Aberystwyth.—The D.P. Battery Co., Ltd., has received the order for the lighting battery for the town of Aberystwyth, consisting of 240 cells of its LL 9-plate type.

Belfast.—The Tramways and Electricity Committee has considered tenders for three-phase plant for the sub-station at Fortwilliam Park for the Cavehill and Whitewell system, and has accepted that of the British Westinghouse Co. on certain conditions. The tender of the B.T.H. Co. for switchboards for tramway depôts was also accepted.

Dartford.—The U.D.C. on June 22nd accepted the following tenders for the extension of the generating plant for tramway load:—

Ruston, Proctor & Co., Ltd., Lancashire boiler with accessories, £836 and £20 extra for lagging.
John Fowler & Co. (Leeds), Ltd., steam dynamo with accessories, £1,101.
Electrical Power Storage Co., Ltd., traction battery and reversible booster, £1,263 10s. with £350 for five years' maintenance.
Ferranti, Ltd., main switchboard and accessories, £451.
Mr. W. F. Blay, Dartford, car sheds, £3,170.

Exeter.—The B. of G. has accepted the tender of the National Telephone Co. for the installation of telephonic communication at the Infirmary, at £42 13s.

Gravesend.—The T.C. has accepted the tender of Mr. S. Blandford, of Gravesend, for the installation of the electric light in Church Street Schools, at £51. The highest tender received was £198, and the lowest, sent in by Messrs. Dixon, of Bexley, £45.

Hammersmith.—The B.C. has received the following tenders for cable:—

Henley's Telegraph Works Co.	£294	0	0
Western Electric Co. .. .. (accepted)	294	18	9
St. Helens Cable Co.	300	0	0
Siemens Bros. & Co.	317	5	0
British Insulated and Helsby Cables, Ltd.	338	0	0
Glover & Co.	357	3	9

Orders have been placed by Hammersmith Borough Council as follows:—Universal Electrical Co., conversion of the street lighting system from rectified to alternating current, estimated cost £500; British Electric Transformer Co., six transformers of 100-KW., £120, six transformers of 5-KW., £87 10s.

Kingston.—The T.C. has accepted the tender of Messrs. Cory & Son, Ltd., for the annual supply of coal to the electricity works at the following prices:—Broomhill, rough, 9s. 11d. per ton; Durham, small (Lambton), 10s. 11d. per ton.

Kirkcaldy.—The Stirling Boiler Co. has received an order for two Stirling boilers fitted with chain grate stokers, each to evaporate 18,500 lb. of water per hour, for the tramways and electric light station.

Kingston.—The Education Committee has received the following tenders for installing the electric light in the Elementary School:—

Offer & Sons, Kingston	£539	10	0
Potter & Sons	409	0	0
R. Dawson	398	10	0
Burgess & Sons, Wimbledon	375	0	0
Grundy & Coombes	356	12	6
Prestwich & Burt, Kingston	320	0	0
Scotcher & Sons, Hampton Wick	359	0	0
Mr. Adams, Kingston	251	0	0
Christian & Phipps, Hampton Wick (accepted)	250	0	0

Leyton.—The U.D.C. on Tuesday accepted the tender of Messrs. Charrington, Sells, Dale & Co. for the supply of steam coal for electric lighting purposes for one year.

Loch Leven Scheme.—The contract for the extensive works, under promotion, at the head of Loch Leven, by the British Aluminium Co. has been given to Sir John Jackson's firm.

Middlesex.—The County Council has accepted the tender of the Metropolitan Electric Tramways, Ltd., in connection with Railway No. 1, for the lowering of the road under Bruce Grove Bridge, Tottenham, and constructing the track, &c., on a schedule of prices which is not to exceed £2,400. The Council, in connection with Railway No. 9, has accepted the tender of Mr. J. T. Bloomfield, at £3,726, for widening that part of the Harrow main road known as Deadman's Hill to 50 feet.

Westminster.—The City Council has received the following tenders for repairs, additions, &c., to the electric lighting installation at the Grt. Smith Street library:—

T. Potter & Sons .. .. .. (accepted)	£102	15	0
Foote & Milne, Ltd.	116	10	0
Sunderlend, Leo & Co.	122	0	0
Lund, Bros. & Co.	124	19	0
Drake & Gorham, Ltd.	130	3	0
Alliance Electrical Co., Ltd.	138	5	6
F. J. Coleby & Co.	171	5	0

Wrexham.—The T.C. has accepted the tender of the Lancashire Dynamo & Motor Co. for a balancer.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 3 p.m. Westminster Palace Hotel. Annual Meeting of the Industrial Freedom League. Address by Lord Avebury, President.

Monday, July 3rd.—At 8 p.m, Faraday Society meeting a the I.E.E. "Some Notes on the Rapid Electro-deposition of Copper," by Mr. Sherard Cowper-Coles; "The Use of Balanced Electrodes," by Prof. W. W. Haldane Gee; "Electrolytic Oxidation of Hydro-carbons of the Benzene Series" (Part II.) and "Electrolytic Analysis of Antimony," by Messrs. H. D. Law and F. Mollwo Perkin; "Notes on Heat Insulation, particularly with Regard to Materials Used in Furnace Construction," by Messrs. R. S. Hutton and J. R. Beard.

Monday, July 3rd to 14th inclusive.—Third International Electric Tramway and Railway Exhibition at the Agricultural Hall, Islington, N.

Tuesday, July 4th to 6th inclusive.—Municipal Tramways Association. Fourth Annual Conference at the Agricultural Hall, Islington, N. (See list of papers in ELECTRICAL REVIEW, June 23rd, p. 1027.)

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued for next week:—

Thursday, July 6th.—Recruits and non-efficients for Felixstowe Camp parade at Liverpool Street Station, G.E.Ry., at 11.15 a.m. Those for Isle of Wight Camp at Waterloo Station at 12 noon.

Saturday, July 8th.—Efficients for Felixstowe Camp parade at Liverpool Street Station, at 11.15 a.m. Those for Isle of Wight Camp at Waterloo Station at 12 noon.

E. H. BUFTON, Sgt.-Inst.
For O.C.E.E.R.E. (V.)

THE MUNICIPAL ELECTRICAL ASSOCIATION MEETING AT EDINBURGH.

THE tenth annual gathering of the above Association was opened at Edinburgh on Tuesday last, when the members and their friends received a very cordial reception from the Lord Provost, Sir Robert Cranston, at the North British Hotel, the headquarters of the Association for the time being.

His genial welcome was echoed by the convener of the Electric Lighting Committee, Councillor Stevenson, and thanks to the numerically large attendance of members and the excellent weather prevailing, a very enjoyable and successful convention resulted. The Lord Provost, in welcoming the members to the city, referred humorously to the financial aspect of the Edinburgh lighting department. It was certainly a very successful undertaking, for which all praise was due to Mr. Frank Newington, the President for the year.

His excellent advice to the speakers to be brief and to the point was, unfortunately, not appreciated at its full value by brother councillors in the various discussions which followed.

Councillor Stevenson, the convener of the Electric Lighting Com-

mittee, associated himself with the Lord Provost in giving the members a cordial welcome. In the course of a few remarks, he stated that the Edinburgh Electricity Department had had no difficulty in making profits, but the difficulty was in keeping them for the benefit of the department. In 10 years their undertaking had grown from some 450 consumers to 8,000, and the output from 880,000 to 11 million units; while financially they were the happy possessors of a reserve amounting to some £78,000.

He urged that among the several factors leading to their present prosperous condition, none was more important than the policy of reducing the price of energy whenever possible, the price at the present time being 3½d. per unit.

Mr. Frank Newington, the chief electrical engineer to the city, after thanking the members for the honour conferred in electing him as their President for the year, proceeded to read his address, which is referred to elsewhere in our columns.

Councillor Robb, of Tunbridge Wells, proposed a vote of thanks to the President for his address, which, he considered, touched on a wide range of subjects in an exceedingly temperate manner, and

Prof. Alex. Kennedy, in seconding the motion, suggested very appropriately that although he was not exactly a brother (municipal) engineer, he could very well claim the position of father.

Councillor Sinclair, chairman of the Electric Light Committee, Swansea, then read his paper on "Load Factor—its Effect upon an Electricity Station."

The paper indirectly called forth considerable discussion, Mr. J. F. C. Snell, the first speaker, evidently holding much more advanced views on electricity supply than the majority of the members, and his contention that the extended use of electricity would lead to the general introduction of the flat rate, Edinburgh being quoted as an example, came in for considerable criticism.

Mr. H. Faraday Proctor, Bailie Willox, Mr. Boot, and a representative from Poplar, also contributed to the discussion, the last "throwing out a hint" of bewildering length and complexity.

Councillor Sinclair having replied, Mr. E. E. Hoadley, chief electrical engineer, Maidstone, read his paper on "Street Lighting." This was very well received, it being a most suitable subject for discussion at the present time, the speakers including Mr. G. Wilkinson, Harrogate; Councillor Stevenson, Edinburgh; Mr. T. P. Wilmshurst, Derby; Mr. S. E. Fedden, Sheffield; Mr. Haydn Harrison, &c.

Although a somewhat hopeful tone pervaded the meeting in regard to the prospects of side street lighting by Nernst lamps, it was evident that there was considerable diversity of feeling on the matter, and Mr. Fedden's remark that it all comes down to a matter of the price of gas in the particular locality, was not far off the mark. The construction of the Nernst lamp, its frailty and other drawbacks, were discussed at length, the opinion evidently being held that it was far from satisfactory in working.

Owing to shortness of time, the discussion was not finished when the members adjourned for lunch.

The meeting was resumed at Glasgow on Wednesday, when the members were welcomed by Sir John Ure Primrose, the Lord Provost, who, in the course of an eloquent speech, referred to the progress and ideals of municipal electrical works, urging the great importance of placing such undertakings in the front rank commercially. Bailie Willox having spoken, Mr. Hamilton Kilgour read his paper on "Notes on Costs and Tariffs for Electric Supply." The paper drew an animated discussion, in which the majority of the speakers favoured the fixing of prices to meet the special conditions rather than adhering to fixed or class systems of charging. Councillor Hodgson's paper which followed drew hostile criticism from brother councillors, and a general expression of opinion in favour of retaining the power supply business at all costs. Subsequently the members were hospitably entertained by the Glasgow Corporation at an excellent luncheon, followed by a no less excellent speech by the Lord Provost, emphasising the necessity of sound finance in municipal work. The remainder of the afternoon was spent in visiting the fine power stations connected with the Corporation tramways and electrical undertakings.

On Thursday, Edinburgh was again the place of meeting, papers on "Extensions to Outlying Areas," and on "Free-Wiring, &c.," being contributed by Mr. A. B. Mountain, borough electrical engineer, Huddersfield, and Mr. A. R. Sillar, borough electrical engineer, Colchester, respectively.

To-day the annual general business meeting of the Association will be held at Edinburgh, after which the members will be free to follow their own inclinations in regard to the several loch tours and a visit to Aberdeen, which have been arranged by the Council for the week end following.

Name Plates.—The SWEETMEAT AUTOMATIC DELIVERY CO., LTD., of Appold Street, London, have sent us a list relating to their commercial nameplate machines, also a specimen embossed nameplate.

Our Canals.—According to the *Daily Telegraph* of Friday last, the Marquis of Salisbury, as President of the Board of Trade, has consented to receive a deputation on the question of the best means of improving the canal communication of the country. The date will depend upon the complete recovery of the noble marquis from his recent illness. An effort will be made to secure the appointment of a Royal Commission to consider the whole subject.

MUNICIPAL ELECTRIC WIRING.

JUST as we go to press the following important letter has come to hand from the hon. secretary of the Electrical Contractors' Association (Incorporated):—

RE L.C.C. GENERAL POWERS BILL.

Referring to your correspondence on the above, I have pleasure in informing you that a petition against the above Bill, signed by electrical contractors in London and sealed with the seal of the Electrical Contractors' Association (Incorporated), has been presented to the House of Lords, asking them to cut out or modify the clauses relating to free or assisted wiring.

On making an appeal to our members for funds to successfully carry on this opposition, eight members from the Northern Section, and four from the London, immediately guaranteed £10 each, and I am sending round a circular letter to all the members of the Association asking if they will follow the good example set them by the said members. On talking the matter over with the members of the Electrical Manufacturers' Association last night, three members promised to subscribe £10, £10 and £5 each respectively to this fund on the understanding that the other members of that Association should make up the subscription to the sum of £100. I should be greatly obliged if you would give this matter prominence in your next issue, so as to amplify the appeal that I am sending out to the members of the Electrical Manufacturers' Association. We have been instructed by our solicitors that a sum of £300 to £400 would be required, and that this amount would have to be paid between now and the end of July.

LEONARD C. TATE, *Hon Sec.*

34 and 35, High Holborn, W.C.,
June 28th, 1905.

NOTES.

The Junior Institution of Engineers.—We offer to the Junior Institution of Engineers our heartiest congratulations on the attainment of its majority which occurs to-day—Friday. Twenty-one years ago to-day its first meeting was held at 84, Barkham Terrace, Lambeth Road, S.E. It was not always called by its present name, for starting as "The Vulcanic Society" among the young engineers employed at the works of Messrs. Maudslay, Son and Field, its name was changed six months later to "The Lambeth Junior Scientific Society," and passed through several other phases before arriving at its present form. The first chairman was Mr. S. H. Wells, now principal of the Battersea Polytechnic, who was very largely responsible for the formation of the society, and in the distinguished roll of past-presidents are the names of Sir Wm. White, Sir S. J. Reed, Sir Wm. Anderson, Sir John Wolfe Barry, Sir Isaac Lothian Bell, Sir Alexander Binnie, the Hon. C. F. Parsons, Dr. John Hopkinson, Profs. Unwin, S. P. Thompson, Perry, A. B. W. Kennedy, and Messrs. Alexander Siemens, Archibald Denny, &c., the present president being Mr. W. H. Lindley, of Frankfort.

It is customary for the Institution to hold a summer meeting in one or other of the great centres of industry, when various works and places of interest are visited. In this, its majority year, the meeting is taking place in London, and commenced last Monday with a reception by the Lord Mayor (Alderman Pound) and Sheriffs, in the Guildhall, who welcomed the members to the City. The Council Chamber was filled by the members and their wives and lady friends. There were quite as many ladies as members. After the customary formalities, the President, Mr. W. H. Lindley, received representatives of kindred societies, including Prof. W. C. Unwin, representing the Royal Society; Dr. A. B. W. Kennedy, representing the Mechanicals; Prof. Meldola, the Chemical Society; and many other leading lights. An interesting address was delivered by the President, who referred to the characteristics of youth, enthusiasm and clearness of vision, and said that whilst he could not wish the individual members the enjoyment of eternal youth, he could, and did, wish it for the Institution.

Luncheon followed the opening meeting, after which the members visited St. Paul's Cathedral, where a special choral service was held, and later took tea at the Mansion House by invitation of the Lord Mayor and Lady Mayoress.

On Tuesday the members visited Woolwich Arsenal, and in the evening a reception was held at the Royal United Service Institution. The guests, who numbered nearly 300, were received by the President and the Chairman and Mrs. Cutler; the museum was open, including the Nelson Centenary Exhibition, and a programme of music, interspersed with songs, was performed by the band of the 21st Lancers. During the evening the Secretary, Mr. W. T. Dunn, was presented with a silver punch bowl by the Institution as a mark of the appreciation of the members for his long services, he having been secretary since 1884; the President and Messrs. Cutler, Marshall, Tennant and Taylor successively eulogised Mr. Dunn's good qualities, while the valuable assistance rendered to the interests of the Institution by Mrs. Dunn was also recognised. Mr. J. P. Maginnis gave a lecturette on the making of steel pens, and Mr. W. J. Harding discoursed on Britain's First Line of Defence.

On Wednesday visits were paid to the Royal Mint; Messrs. Yarrow's Works, Poplar; the North London Railway Works, Bow; and the Greenwich generating station and New Cross depôt of the L.C.C. tramways.

Yesterday there was to be an excursion in the *Clacton Belle* to Chatham for the inspection of the Dockyard. To-day Messrs. Doulton's potteries and the Neasden power house of the Metropolitan Railway will be visited, and finally there will be a gathering, followed by a "birthday" dinner, at the Earl's Court Exhibition.

Electric Power Work in South African Mines.—A paper was recently read in Johannesburg by Mr. A. W. K. Peirce, before a meeting of the South African Association of Engineers, on the "Electrical Equipment of Mines." His remarks were based upon the requirements of a moderately deep level mining property equipped on a 200-stamp basis. The powers required are given as approximately the following:—

Crusher and sorting stations (including belts or other conveyors to mill)	150 KW.
Cyanide works. Power required for pumps, &c., in extractor house...	50 ,,
Slimes plant (sludge and solution pumps, &c.)... ...	120 ,,
Return water pumps	30 ,,
Shops	40 ,,
Miscellaneous small motors on the surface for various purposes...	20 ,,
Mine pumping (allowing for pumping 200,000 gallons per day 2,000 ft. high in 20 hours actual running time)	100 ,,
Lighting underground	15 ,,
Total day load	525 KW.

A generating plant large enough to deal with the above would be large enough also to supply any surface lighting, as this would not be required before 5.30 p.m., after which time a portion of the motor load would be off. The author would advocate for the above duty two 500-KW. sets, one being a standby. The system he would adopt would be three-phase 50-cycle, the lighting being single-phase, taken from one selected phase of the machine, and using an automatic voltage regulator for maintaining constant voltage on this phase. It is not obvious why the author proposes this as, by dividing his lighting into three sections, putting one-third on each phase, no automatic regulator would be required if the motor load and power factor were reasonably uniform.

In order to minimise cost of cables a voltage of 2,000 is proposed, transformers being located near the larger groups of motors. The primaries of these transformers would be connected delta fashion, and the secondaries in star, 200-volt motors being used and the lights taken from the centre of the star and one of the line wires, the lighting voltage being, therefore, 120. For outdoor arc lighting, if 20 or more are required, a constant current transformer would be used, the lamps being connected up in series.

Cost of Promoting L.C.C. Bills.—Mr. T. Barclay Cockerton, in reporting the results of his audit of the accounts of the London County Council for 1904-5, refers to expenditure which he considered to be illegal, but as the Local Government Board sanctioned it under the Local Authorities (Expenses) Act, 1887, he has been relieved of the necessity of making disallowances and surcharges. The expenditure in question includes £643 as the expenses of promoting the L.C.C. (Electric Supply) Bill, 1902, £326 for promoting a similar Bill in 1903, and £639 as the expenses incurred in connection with the opening ceremony of the electric tramway service in South London.

The Electrical Contractors' Association.—The annual dinner of the Electrical Contractors' Association was held on Tuesday evening last, in the King's Hall, Holborn Restaurant, with the President, Mr. Rawlings, in the chair.

After the usual loyal toasts had been honoured, Mr. R. Tweedie Smith, the hon. solicitor to the Association, himself, we believe, a candidate for Parliamentary honours, proposed the "House of Commons," to which Mr. Mark Beaufoy, an ex-M.P., replied in a good and humorous speech.

Mr. E. L. Berry was called upon to give the toast of the "Councils and Municipalities," and after deprecating his ability to deal with the matter in anything like an adequate way, proceeded in a very exhaustive dissertation to tell us what the municipalities might and ought to do and what they had no business with, and should therefore leave severely alone. They were constituted to deal, said Mr. Berry, with big things, but they meddled with minor matters and were taking the bread out of the mouths of the poor electrical contractor (Mr. Berry had just enjoyed a capital dinner). Generally, his remarks formed a stinging tirade against the L.C.C. and its satellites taking up the business of electrical contracting.

The toast being coupled with the names of Mr. Gomme, clerk to the L.C.C., and the Mayor of Shoreditch, the former gentleman, endeavoured to argue that the extension in all directions of work, large as well as small, by municipalities, was good for trade. If business men were hurt in one direction there would be a corresponding development of industry in another; the logic of which failed to convert his listeners to a very profound belief in the wisdom of those who steer the L.C.C. ship.

He insinuated, if our ears did not deceive us, that the L.C.C. had only gone in for wiring, through fear that electrical contractors might not do the best kind of work—a gratuitous slight to a body which is striving to make the work of its members the very best of its kind—and that there existed no real intention of competition. In Germany, he said, the contractors do not look upon municipal work as antagonistic to private enterprise; municipal extensions were rather supported by business men such as are represented by the Electrical Contractors' Association!

The racy speech of the Mayor of Shoreditch was in direct contrast to the opinions expressed by Mr. Gomme. Shoreditch, said Mr. Bird, before there were any wiring contractors in the district, had started an electrical trade, found it to be a grave mistake, and had given it up. He invited wiring contractors to migrate to Shoreditch—there were only two or three settled there now—and they would be made welcome and encouraged. They would be rated as high as was possible, but, as ratepayers, they would be left to do their legitimate business, and every facility would be offered them. Shoreditch would produce the electrical energy, and let the contractors do the fittings and wiring work. Municipal men, remarked the Mayor, do not work as company men labour—a truism long known to everybody except to municipalities—and the tone of his excellent oration throughout was in deadly opposition to the interference by municipalities in things which should be left to private enterprise.

Our own views on municipal wiring have only recently been very forcibly expressed, so there is no need to enlarge upon that theme again here, but let the electrical contractors more than ever strive to live up to the *fortiter in re* part of their motto!

The remaining toasts were those of "The Electrical Contractors' Association," to which Mr. Rawlings replied, and the "Institution of Electrical Engineers and Kindred Associations," coupled with the names of Mr. Dykes, Mr. Davenport (secretary of the Electrical Manufacturers' Association), and Mr. Howard (secretary of the Cable Manufacturers' Association). The tables were laid for a company of about 220, the dinner was good, the speeches (with, perhaps, one or two exceptions) were very much to the point, and commendably brief, and the after-dinner programme was enlivened by a trio of vocalists, and by Mr. Berry, who looked a foine ould Oirish gintleman in "Killaloe," a song admirably adapted to his sad, sorrowful and solemn countenance. The manner, too, in which he flourished that make-believe shillalah every time he caught the eye of the estimable clerk to the L.C.C made us rejoice that the width of the room intervened.

Finally, we may add that the King's Hall was, for the first time, beautifully lighted by Excello arc lamps. These are 80 ft. from the ground, of the 6-ampere type, taking 280 watts each.

South African Notes.—DURBAN.—As the result of the cyclone which lately visited Natal, the Durban electric tramway service was absolutely suspended. Great damage was done to the track and power cables.

BLOEMFONTEIN.—At a meeting of the T.C. a letter was read from the Government, stating that his Excellency the Governor, with the advice of the Executive Council, had agreed to the terms of the contract entered into by the T.C. with Messrs. Davies and Spain for erecting and exploiting electric tramways in the city.

Gas.—A serious gas explosion occurred at Green Lanes, Harringay, on 27th inst., killing two children and injuring both their parents.

Electricity Works Table.—Errata.—

BRIDLINGTON: Under the heading of "Public Lighting," the data are given in terms of *equivalent* 8-C.P. lamps.

CHELMSFORD: The output for the year should read 477,524.

Photography to Blame for Electrical Engineering.—According to the *Amateur Photographer*, electric lighting, tramways and power all arose out of photography. "All the above industrial realisations depend on the Gramme machine and its reversibility, and the Gramme ring arose in this way. In the early or mid sixties M. Zenobie Theophile Gramme became photographic assistant to Mr. Woodbury, who at that time was engaged in working out his well-known method of photo-mechanical printing, and in order to provide electric light for printing the gelatine reliefs, Mr. Woodbury set up a Wilde's dynamo and a Lenoir gas engine to drive it, both being pioneer forms, the value of which Mr. Woodbury realised. Gramme being of a mechanical turn of mind, naturally looked after the engine and dynamo. Soon after, M. Gramme replaced the single winding of the Sturgeon armature, as used in Wilde's dynamo, by that wonderful conception the ring electro-magnet or Gramme ring."—Q.E.D.!

For Sale.—A charging booster set and battery are offered for sale by the Wrexham Electricity Department. See our advertisement pages to-day.

Electric Shock Fatality.—At Lambeth, on Monday, an inquest was held into the death of Alfred Edwin Gray (Bessant and Gray, electricians, Kennington Lane), which occurred on 23rd inst. while he was engaged at work adding an extra light in the basement of some premises at Kennington Lane where an installation had just been completed. His partner, Mr. Bessant, who gave evidence, said that he went to remind the deceased, who was his brother-in-law, that it was dinner time, when he saw him fall dead. Gray had a pair of pliers in his hand with the end of a wire in them. The current was supplied by the South London Electric Supply Corporation, at 220 volts. He did not think that the current in itself would be sufficient to cause death; 220 volts was supposed to be safe for ordinary purposes. Gray had always been nervous about receiving a shock, and possibly fright affected him. He thought the accident was due to the fact that his brother-in-law was standing on damp earth, which formed the floor of the basement, and that the nails in his boots had something to do with it. It was customary to cut the current off before commencing work, but it was not done in this case. Mr. Bessant went on to say that under similar circumstances he had been able to release his hold of the pliers when the voltage had been as high as in this case, but the current was apt to take away one's power to a certain extent—it depended on a person's constitution.

Dr. Roe certified that death was due to an electric shock of a continuous kind, which caused rigidity of the muscles and arrest of respiration. He was satisfied that death was not instantaneous, but slow.

Mr. G. S. Ram, Home Office inspector, gave evidence respecting the possibility of releasing one's hold of a "live" wire. Experiments by a Continental professor with alternating currents showed that the point at which he could not release his grip was 96 volts. It might happen with a current in domestic use, as in this case, that a man would not be able to let go, but in the ordinary way the risk did not exist, as there was nothing but properly insulated parts to come in contact with the hand. This accident occurred through disregard of two elementary rules. Notice should have been given to the supply company, and the current should have been cut off before work was commenced.

The jury returned a verdict of "Accidental Death."

The New York Subway: A Claim.—The New York correspondent of the *Morning Post* says that a British naval officer, Captain Marlin Stuart, is suing Mr. August Belmont, the President of the Interborough Rapid Transit Co., for $75,000 damages. Capt. Stuart was injured by an explosion on the Subway while it was under construction in 1902, and he claims that the injuries were so severe that he was forced to retire from the British Navy.

County Councils Association and Supply of Electricity Bill.—At a meeting of the Executive Council of the County Councils Association, held on Wednesday, the Parliamentary Committee reported as follows:—"That this Committee are in favour of the adoption of the 'Lancashire Clauses' for the protection of County Councils with respect to bridges, with the object of getting them introduced into the Supply of Electricity Bill; that this Committee are in favour of steps being taken to ensure the insertion in the Supply of Electricity Bill of the following clause:—'Except as in this Act otherwise expressly provided, no electric lines shall be placed overhead, along, across, or by the side of any road repairable by the County Council, or any bridge under their jurisdiction or repairable by them, or any approach thereto, without the consent of the County Council, to be given or withheld at their absolute discretion;' that Mr. Jeffreys be authorised to take such steps as he may consider necessary to get the above clauses inserted in the Supply of Electricity Bill. The Committee considered a request from the Hertfordshire County Council for assistance in obtaining the insertion of the 'Lancashire Clauses' in the Act of Parliament confirming the St. Alban's Electric Lighting Order, 1905. The secretary was instructed to inform the Hertfordshire County Council of the resolutions passed by the Committee with respect to the Supply of Electricity Bill."—The report was adopted.

Institution Notes.—Royal Meteorological Society.—At last week's meeting Mr. G. C. Simpson read a paper on the "Normal Electrical Phenomena of the Atmosphere."

Society of Engineers.—A highly interesting visit was made by the President—Mr. Nicholas J. West—and members of this Society on Wednesday last to the Lot's Road electric power generating station of the Underground Electric Railways Co. of London, by kind permission of Mr. James R. Chapman, the company's chief engineer. The visitors were courteously received and conducted over the works by the resident engineer, Mr. J. W. Towle.

Manchester Geological and Mining Society.—Last week at Manchester, a paper on "Electrical Pumping at Collieries" was read by Mr. Gerald K. Hooghwinkel. The paper was illustrated by photographs and lantern slides.

Municipal and County Engineers.—At the Norwich meeting last week, Mr. Joseph Owen, of Colchester, read a paper on "Tramway and Permanent Way Materials and Construction."

Accumulators Without Lead.—Prof. K. Elbs, of Giessen, read a paper on the above subject before the last general meeting of the German Bunsen Society. Dealing with iron accumulators, he remarked that the passivity of iron in concentrated alkali solutions can be prevented by heating iron filings in air, reducing them in a current of hydrogen, and then submitting them to cathodic polarisation in caustic potash. Such iron works fairly well as anode, but the grains cannot be "formed" through and through, as a kernel of metallic iron always remains in the centre. It is impossible to say anything definite about the oxidation process. Apparently, a hydroxide of ferrous iron is formed, for the yellow-brown ferric hydroxide, which is easy to recognise, is only produced after additional oxidation in the air. Moreover, the substance is very difficult to reduce at the cathode. The capacity of an iron alkaline accumulator does not increase after repeated employment, because, as already mentioned, the iron cannot be completely "formed." The solubility of nickel oxides in caustic potash is very small, but that of cobalt oxides is high, so that the latter are not suitable for the construction of accumulators. The E.M.F. of the freshly charged cell is 1·42 to 1·48 volts, falling slowly on standing and rapidly during discharge to 1·35 or 1·37; 1·36 volts may therefore be considered the normal working voltage. It is independent of the concentration of the liquid in the cell.

The B.A. 1907 Meeting.—On Friday last week a special meeting, convened by the Lord Mayor, was held in the Mansion House, Dublin, for the purpose of considering a recommendation to invite the British Association for the Advancement of Science to hold its annual meeting in 1907 in Dublin. The proposal was carried unanimously.

Appointments Vacant.—Lecturer on electrical engineering for the Hull Municipal Technical School (£200); jointer for Wishaw (35s.); switchboard attendant for Stockton-on-Tees (27s. 6d.); engineer for Youghal Auxiliary Asylum; assistant lecturer for the South-Western Polytechnic Electrical Engineering Department (£150); assistant engineer for King's Lynn (£80); traffic superintendent for Halifax Tramways (45s.). A "head" is required for the Electrical Engineering Department of the Halifax Municipal Technical School (£200); also one for the Civil and Mechanical Engineering Department (£200).

Magnetic Compounds of Non-Magnetic Elements.—A paper was read by Prof. E. Wedekind, of Tübingen, before the last general meeting of the German Bunsen Society, upon the magnetic properties of certain compounds of elements which are themselves non-magnetic. Manganese boride is magnetic, both in the crude compact state and in that of the pure black powder. The latter was compared with powdered iron, as it cannot be melted without decomposition. It was found to require a relatively powerful field to saturate it, being about half as magnetic as iron. The compound of manganese and antimony (manganese antimonide) can be saturated very quickly, and is about one-third as magnetic as iron. The compound of manganese and bismuth is also faintly magnetic, although bismuth itself is not at all so. These substances are not exactly alloys, but rather compounds, for chlorine does not attack them, and they conduct electricity badly. The magnetism is remanent, a tube filled with powdered manganese boride placing itself in a north and south direction.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—On Wednesday, June 21st, the staff and men employed at the Tunbridge Wells electricity works held their annual outing, Brighton being chosen as the rendezvous, and Mutton's Hotel along the sea front was headquarters. The men drove in the morning by char-a-banc to the Dyke, where all sorts of sports and amusements were indulged in. The consulting engineer and general manager, Mr. Horace Boot, M.Inst.E.E, presided at the dinner, and was supported by Mr. John Christie, the borough electrical engineer of Brighton, Mr. David Smith, the chief assistant engineer, and Mr. W. H. Hayden, the chief clerk. The "Staff and Absent Members" was proposed by Mr. Boot in a humorous speech. He referred to his excellent staff, and wished specially to thank Mr. D. Smith and Mr. W. H. Hayden for their loyal services. It was with feelings of great pleasure he touched upon the point of members of the staff and men desiring to return and again serve under his generalship; in fact, that day no fewer than seven of those around him were old and trusted servants who had left for other appointments, and finally came back to him. He felt that this must speak volumes for the way the men were all treated, and although the salaries were not as high as many of the men thought they ought to be, he valued their services, and regretted that owing to the keen competition it was impossible to pay them more than the average rate for such services. He coupled with this toast the names of Mr. A. R. Walter (mains department) and Mr. F. Maltby (works department), and both of these gentlemen responded. "The Visitors" was proposed by Mr. Boot, coupled with the name of Mr. John Christie, who briefly replied. Mr. W. H. Hayden, the hon. treasurer, then submitted the balance-sheet, which showed that after paying the whole of the expenses of the outing, each man received in addition thereto 10s. 9d., leaving a balance to be carried forward to next year's account of 2d. "The Chairman" was the final toast.

The Watford Council, on the E.L. Committee's recommendation, has resolved to increase the salary of Mr. Weston to £150, and those of Messrs. Osborne and Hick, engineers-in-charge, to £75 per annum.

The Southend T.C. has increased the salary of Mr. Jones, shift engineer.

Instead of appointing a successor to Mr. L. P. Greig, the Bury St. Edmunds T.C. has decided to give the present staff at the works a trial for three months.

Mr. J. A. Crowther, of Bristol, has been appointed mains superintendent at Coventry.

The employés at the Burnley Corporation electricity works have presented a silver-plated tea and coffee service to Mr. Birkett, late borough electrical engineer. Mr. Birkett returned from Southend to attend the presentation on 20th inst.

Southampton Electricity and Tramways Joint Committee has fixed the salary of Mr. Street, electrical and tramways engineer, at £650 per annum, which will be equally borne by the two departments.

Mr. William Clark, of the Falkirk Corporation electricity works, has been appointed switchboard attendant at Greenock Corporation electricity works.

Battersea Borough Council, on Wednesday, elected Mr. A. P. MacAllister, its mains superintendent, to be chief assistant electrical engineer at a salary of £200. There were 152 applicants.

Tramway Officials.—Mr. Herbert Vickers, assistant tramway engineer to Wolverhampton T.C., was married at Bolton on June 22nd to Miss Bertha Thornley.

Mr. Bamber, the newly-appointed manager of the Keighley Corporation Tramways, has been presented with a gold albert and medal by the staff of the Halifax Corporation Tramway Department.

General.—Mr. A. S. L. Barnes, assistant electrical engineer at Gibraltar, was recently presented by the Sanitary Commissioners of Gibraltar staff with a silver rose bowl on ebony pedestal on the occasion of his marriage.

In this column last week we mentioned the retirement of Mr. Brunton from the position of works manager at Crompton & Co., Ltd., Chelmsford, but we were in error in stating that he had been with the firm for a quarter of a century, for 14 years is the exact period of his connection with the firm. We trust that Mr. Brunton will be actively engaged for a great many years to come in his profession, in the practice of which he has had invaluable experience in works construction and management and manufacturing processes and methods.

A Cardiff paper says that while Mr. Alexander, electrical wire inspector under the Swansea Corporation, was engaged on a raised trolley repairing a wire at the Hospital junction, one of the wires was carried away, and striking him, it threw him to the ground, a fall of 20 ft. He was picked up in a semi-conscious condition. He had sustained a severe wound on the forehead.

Obituary.—It is reported that Mr. Percy Dewhirst, A.I.E.E., of Blackpool, was drowned in Lake Windermere on Sunday evening. He went out for a row, but the empty boat was discovered later on in the middle of the lake. It had not capsized.

NEW COMPANIES REGISTERED.

Works Construction Co., Ltd. (85,014).—This company was registered on June 22nd, with a capital of £71,000 in £1 shares (70,000 ordinary and 1,000 "B"), to adopt two agreements with J. G. White & Co., Ltd., to acquire any tramways, railways, light railways, telegraph and telephone lines, electric, hydraulic and other works, &c., in Brazil or elsewhere, and to carry on the business of tramway, light railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers of and dealers in vehicles and rolling stock of all kinds, makers of accumulators, dynamos and other things used in connection with the construction, manufacture, maintenance, working and equipment of tramways, railways, and vehicles, suppliers of electricity for light, heat and motive power, &c. The first subscribers (each with one ordinary share) are:—A. J. Brough, 75, Lombard Street, E.C., accountant; A. T. Escott, 24, Durlston Road, Clapton, N.E., cashier; G. H. H. Chambers, 25, Mervan Road, Brixton, S.W., accountant; E. J. Trollope, 164, Kennington Road, S.E., clerk; M. H. Hearn, 66, Lanercost Road, Tulse Hill, S.W., clerk; J. W. Pollard, 13, Harkwood Road, Shepherd's Bush, W., clerk; and J. Barrier, 40, Brunswick Road, Leyton, clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £900 each per annum (£600 for the chairman).

Electrical Distribution of Yorkshire, Ltd. (84,972).—This company was registered on June 19th, with a capital of £10,000 in £1 shares, to carry on in the West Riding of Yorkshire or elsewhere the business of suppliers of electricity and gas for light, heat, motive power or otherwise, electricians, electrical, metallurgical, mechanical and chemical engineers, manufacturers of and dealers in all apparatus and things connected with the generation, distribution, supply, accumulation, and employment of electricity and power gases, &c. The first subscribers (each with one share) are:—A. G. Lupton, Roundhay, near Leeds, woollen manufacturer; W. B. Woodhouse, 34, Avenue Hill, Leeds, engineer; J. J. H. Stansfield, Runswick, Broadgate Lane, Horsforth, chartered secretary; H. C. Embleton, The Cedars, Methley, Leeds, mining engineer; E. Lupton, Moorlands, Headingley, Leeds, woollen manufacturer; J. S. Webb, Hollin Lane, Far Headingley, Leeds, auctioneer; and H. H. Kitson, St. Ann's Grange, Burley, Leeds, ironmaster. No initial public issue. The number of directors is not to be less than three nor more than ten; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Strathclyde Electricity Co., Ltd. (5,911).—This company was registered in Edinburgh on June 22nd, with a capital of £1,000 in £1 shares, to carry on in the United Kingdom the business of an electricity supply company in all its branches. The first subscribers (each with one share) are:—Sir Davis Richmond, Broompark, Pollokshields, Glasgow, tube manufacturer; C. King, Milton of Campsie, chemical manufacturer; A. Rintoul, 81, Hope Street, Glasgow, corn factor; J. H. Luback, 2, Norfolk Street, Strand, London, engineer; J. Mackenzie, 150, St. Vincent Street, Glasgow, solicitor; R. Robertson, 154, West George Street, Glasgow, C.E.; and D. Starr, 53, Bothwell Street, Glasgow, engineer. Names of the first directors not stated. Registered offices, 53, Bothwell Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue on June 21st of a debenture for £100, part of series created by resolutions of November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Miss H. Heybourne, Clive Cottage, The Warren, Manor Park, E. No trustees. Previously issued of same series, £33,700.

Yorkshire (West Riding) Electric Tramways Co., Ltd. (84,167).—A trust deed dated June 6th, 1905, to secure £275,000 debenture stock, has been registered. Property charged: Benefit of agreement with Wakefield and District Light Railway Co., certain shares in the said company, and the company's undertaking and property, present and future, including uncalled capital. Trustees: H. S. Leon, Bletchley Park, Bucks; and G. Kitchin, Avenue Road, London.

Electric Lighting and Traction Co. of Australia, Ltd. (63,334).—This company's annual return was filed on June 6th, when 4,834 ordinary and 30,000 preference shares had been taken up out of a nominal capital of £300,000 in 30,000 ordinary and 30,000 preference shares of £5 each. £5 per share has been called up on 2,003 preference and 30,000 ordinary, and £160,015 has been received. £14,155 is considered as paid on 2,831 ordinary. Mortgages and charges: £250,000 (debentures, £150,000; bank loan, £100,000).

Rawlings Bros., Ltd. (67,908).—This company's annual return was filed on June 14th, when 38,169 ordinary and 20,685 preference shares had been taken up out of a nominal capital of £100,000 in 70,000 ordinary shares and 30,000 preference shares of £1 each, and £1 per share had been called up, resulting in the receipt of £58,854. Mortgages and charges, £1,840.

Indo-European Telegraph Co., Ltd. (3,953).—This company's annual return was filed on May 17th, when 17,000 shares had been taken up out of a nominal capital of £450,000 in 18,000 shares of £25 each. £25 per share has been called up and £425,000 has been received. Mortgages and charges: Nil.

Cuba Submarine Telegraph Co., Ltd. (4,710 C).—This company's annual return was filed on May 10th, when the entire capital of £220,000 in 16,000 ordinary and 6,000 preference shares of £10 each had been taken up and paid for in full. Mortgages and charges: Nil.

Calcutta Tramways Co., Ltd. (14,764).—This company's annual return was filed on June 6th, when 137,610 shares had been taken up out of a nominal capital of £700,000 in 140,000 shares of £5 each. £5 per share has been called up on 46,820 and £1 per share on 32,610 shares, and £372,510 (*sic*) has been received. £185,100 is considered as paid on 58,180 shares issued as fully paid (*sic*). Mortgages and charges: £350,000.

Oriental Telephone and Electric Co., Ltd. (40,691).—This company's annual return was filed on May 13th, when 179,813 ordinary and 50,000 preference shares had been taken up out of a nominal capital of £300,000 in 200,000 ordinary and 100,000 preference shares of £1 each. £1 per share has been called up on 7,186 ordinary and 50,000 preference shares, and £57,828 10s. has been received, including £12 10s. paid on 50 ordinary shares forfeited. £171,497 is considered as paid on remaining ordinary shares. Mortgages and charges: Nil.

Brisbane Electric Tramways Investment Co., Ltd. (67,853).—This company's annual return was filed on June 2nd, when the entire capital of £750,000 in 75,000 ordinary and £75,000 preference shares of £5 each, had been taken taken up. £750,000 is considered as paid. Mortgages and charges: £425,000.

CITY NOTES.

J. G. White & Co.

Lord Arthur Butler presided at the meeting held at College Hill, E.C., and in moving the adoption of the report, said that Mr. White was detained in America. They could have wished, of course, that the profit had been larger, but still it showed an improvement as compared with the year's results to February, 1904, and this, in view of the low percentages of profit obtainable in competitive tramways contracts was a matter for congratulation. The present position of the business was very satisfactory, as the company had in hand work of very considerable magnitude; in fact, considerably more than it had ever had in hand at any one time. The contract work actually in hand at date exceeded £1,750,000, and some considerable portion of this was being carried out in foreign countries, where the directors anticipated that the profits would be considerably larger than on tramway contracts carried out in Great Britain. He also called attention to the number of cases referred to in the report where contracts for the complete construction of tramways had been secured. This was a particularly gratifying feature, as indicating that the scope of the business was widening. Since the issue of the report certain negotiations which had been entered into by the company for securing business in Brazil had resulted successfully, and although formal contracts had not yet been signed, a further addition of £400,000 would be made to the total of the contract work in hand. The report was adopted. Dividends at the rate of 6 per cent. per annum on the cum. pref. shares and at the rate of 6 per cent. per annum on the ordinary shares were declared.

Greenwood & Batley Ltd.

The report for the twelve months ending March 31st states that, after providing for interest on the debentures and expenses of management, and making due provision for doubtful accounts, the accounts show a profit of £32,190, making, with £3,668 brought forward, a total of £35,859. Of this sum the directors have written off £7,500 for depreciation of plant, and have added £5,000 to the reserve fund, thereby increasing it to £35,000, and they recommend that dividends be declared at the rate of 7 per cent. per annum on the paid up cumulative preference share capital and of 6 per cent. per annum on the paid up ordinary share capital, absorbing £17,333, and leaving a balance of £6,026 to be carried forward.

Cleveland and Durham County Electric Power Co.

At the annual meeting Mr. W. S. B. McLaren, in moving the adoption of the report and balance-sheet, stated that at the present time the subscribed capital of the company, including shares and debentures, now amounted to £275,000. Their company had at present two power stations completely equipped and ready to supply current. The Bishop Auckland (Tindale Crescent) station had 1,000 H.P. of engines, and the Consett a 720-H.P. station. It was the expectation that within a short period both of these stations would have to be enlarged. In the case of the Bishop Auckland station current has been supplied to customers for some time. They were now commencing the erection of a power station on the south side of the Tees at Eston Grange, near Middlesbrough, where they were putting down 6,000 H.P. They had every reason to think that that power station would be in great request, and that the load there would soon be contracted for.

United River Plate Telephone Co.

The directors' report shows that the gross receipts in sterling for the year ended March 31st last in the River Plate were £151,085, as against £134,824 for last year. Deducting debenture interest, dividend on preference shares and interim dividend on ordinary shares, and adding interest on investments and transfer fees, there remains a profit of £41,663 15s., to which must be added £3,429 brought forward from the previous year, leaving an available balance of £45,091. Owing to the renewal and improvement of some of the most important trunk lines, and the general rise in wages consequent on the enhanced cost of living in Argentina, there has been an exceptional increase in the River Plate expenses. After putting aside £10,000 for renewal of plant and transferring the sum of £15,000 to the reserve fund, the directors recommend that a final dividend of 5 per cent. be paid upon the ordinary share capital of the company, making, with the interim dividend paid December 31st last, a return of 8 per cent. for the year, free of income tax, and that the balance of £2,591 be carried forward. The business of the company continues steadily to increase, and, as anticipated, further capital is required. It is therefore intended to make an issue of £50,000 in ordinary shares, which will be offered to the ordinary shareholders at par. The directors regret to announce that the managing director, Mr. Frank Williams Jones, who has been connected with the company from the beginning, has felt obliged, on account of ill-health, to retire from the board.

Prospectuses.

South Metropolitan Electric Light and Power Co., Ltd.—In order to complete the purchase of the undertaking of the Crystal Palace District Electric Supply Co., Ltd., and to meet the continuous increase in the company's business, the directors are offering to the shareholders and debenture stockholders a further £51,708 4½ per cent. first mortgage debenture stock at £105, 16,300 ordinary shares and 32,600 7 per cent. cumulative preference shares, all of £1 each, at 21s. 6d. per share.

Messrs. J. Stone & Co., Ltd.—This company is inviting applications for 20,000 5 per cent. preference shares (£10). The firm has carried on business at Deptford for the past 60 years as brass, copper and iron workers, &c., and one of their specialities has been the well-known Stone electric train lighting system. The list was to close yesterday.

Edmundson's Electricity Corporation.—The directors have recommended a final dividend on ordinary shares of 9 per cent. per annum for the half-year ended March 31st, 1905, making with the interim dividend of 5 per cent. already paid, a dividend of 7 per cent. for the year; they have also recommended a dividend at the rate of 7 per cent. per annum on 10,000 new ordinary shares issued in November, 1904. The annual general meeting will be held on July 6th, and dividends will be paid on July 11th.

W. & T. Avery, Ltd.—The directors recommend a further dividend of 7½ per cent. on the ordinary shares, which, with the interim dividend paid, will make 10 per cent. for the year ended March 31st last, free of income-tax.

Stock Exchange Notice.—The Committee has appointed a special settling day, as under:—Wednesday, June 28th: Calcutta Tramways Co., Ltd.—32,610 shares of £5 each, £1 paid, Nos. 105,001 to 137,610; and ordered same to be quoted in the Official List.

Royce, Ltd.—A Sheffield paper says that the directors regret their continued inability to pay the dividend on the cumulative preference shares, which is now two years in arrear. They recommend issuing further debentures, not exceeding £20,000, chiefly with a view to secure increased capacity at the works. A meeting of preference shareholders is convened to obtain the necessary authority.

STOCKS AND SHARES.

Wednesday Evening.

Little has so far happened this week to alter the diplomatic horizon, but the Stock Exchange came to the conclusion on Tuesday that the Moroccan problem would not be so difficult to solve after all. Prices thereupon began to improve, and while general business remains scanty, the outlook for the immediate future is less unsettled. Electrical securities have improved in a good many cases, the advances being most prominent amongst Telegraph issues.

Of the various stocks and shares offered within the last week or two, the public have taken certainly as much as the promoters could have expected. The Debenture issue of the Oriental Telephone Co. left the underwriters with comparatively little stock on their hands, and what remained has been the subject of inquiry from investors since. The London United Tramways Co. met with a very respectable measure of success in their issue of Debenture stock, but it is stated that the Victoria Electric Supply offer was not cordially welcomed. The South Metropolitan Electric and the Isle of Wight Electric Companies are both raising more capital, and several other small issues are on the point of putting in an appearance.

Electricity Supply prices have changed but slightly. City of London Preference fell ⅛ to 14, and County of London Ordinary lost ¼ at 8½, St. James's registering a similar decline at 14. Westminster Preference are ⅛ better at 6⅝, and the Ordinary shares are being freely dealt in at a trifle under the top price of 13. A few Debentures show alterations that possess no significance. The 5s. fall in Metropolitan Electric is a natural reaction after the recent sharp rise.

Relief is long in coming to holders of electrical railway stocks. Central Londons gave way, the Ordinary a point, and the Deferred 2 points, upon the announcement that electrified trains will begin to run over the Inner Circle on Saturday, July 1st. That the new service, when completed, may cut into Central London traffics rather severely at first, seems more than probable, but the demands for locomotion in and around the Metropolis, ought to provide plenty of passengers for all the West of London systems. Metropolitans relapsed to 92 upon the fairly obvious inference that the dividend will be reduced, but subsequently that price improved to 93, and Districts hardened a point to 38½.

Some people seem to think that under electrified conditions the District will be able to pay a dividend on its Ordinary stock! A dividend upon Chartered shares would appear at least equally probable. Great Northern and City Preferred "A" shares stick at 5. Baker Street and Waterloo Debenture is 102, and quiet buying of Great Northern, Piccadilly and Brompton Debenture has advanced the price another ½ per cent. to 51, which is a point above that of the less popular Charing Cross and Euston Debenture also recently issued by Messrs. Speyer Bros. At 40 City and South London merely marks time. The dividend for the first half of 1904 was at the rate of 2½ per cent. per annum, and the price of the stock this time last year stood nearly 10 points higher than it does now.

Rises abound in the Telegraph and Telephone list. West India and Panama First Preference put on a further 10s., making the price 8¼, but the Second Preference have not improved upon their last week's advance. Amazon Debentures at 91½ are 4 up, several other prior-charge stocks adding 1 or ½ per cent. to their quotations. Eastern Extensions have yielded the 5s. they gained, falling back to 14, but Eastern Telegraph stock continues at 142½. There is a 10s. rise in West African Telegraphs, making them 8⅞. Cuba Telegraph Preference advanced ½ to 17, Direct Spanish Preference ¼ to 9¼, and Globe Telegraph and Trust Ordinary ⅛ to 10⅝ upon the dividend. Weakness in Great Northern Telegraphs leaves the price at 33½, and Western Telegraphs are ¼ lower at 13⅜. The general hardening of the market is due partly to actual demand, partly to intelligent anticipation of investment requirements later on. Some of the changes were made without any stock being negotiated.

While National Telephone Preferred fell ½ to 111½, the second Preference shares and the two Debenture stocks both improved to the same extent. Chili Telephones rose ¼ to 7, and the United River Plate trio have not yet responded to a very favourable report.

Notwithstanding the success of the London United Tramways new issue, the Preference shares are ¼ lower at 10, and the Debenture stock shaded off to 101. Anglo-Argentine Ordinary at 8½, the Preference at 6$\frac{3}{16}$, and Belgrano Ordinary at 3½, are practically unchanged, but Belgrano "B" Preference fell ⅛ to 5½. British Columbia Electric Railway Deferred and Preferred are 106½ and 99½ respectively. Calcuttas remain dullish at 8$\frac{5}{16}$, and there is nothing of interest to chronicle as regards British Electric Tractions. At 2$\frac{9}{16}$ British Westinghouse Preference have not moved from their last week's level.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations June 21st.	Closing Quotations June 28th.	Business done week ended June 28th, 1905. Highest	Lowest.
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	100 —103	100 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼— 2¾	2¼— 2¾	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	85 — 90	89 — 94	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	59 — 61	59 — 61	59	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	105 —106	105½—106½	106⅜	105
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15 — 15½	14⅝— 15⅝	15	14⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜— 6⅝	6⅝— 7⅛	7 1/16	7
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	..	..	..	..
1,932,856£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97½ — 99½	97½ — 98½	98¼	97½
16,000	Cuba Telegraph	10	6⅛%	10 %	5 %	8 — 8½	8 — 8½	8½	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	16 — 17	16½ — 17½	17	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	8¾ — 9¼	9 — 9½	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4⅜%	4½%	102 —104	102 —104	..	..
60,710£	Direct United States Cable	20	3½%	3 %	..	11⅛— 11⅜	11⅛— 11⅜	11⅜	..
78,500	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	4½%	4⅜%	4½%	100 —102	101 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	141 —144	141 —144	143½	142
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3⅜%	..	90 — 92	90 — 92	91½	90
1,836,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	107⅝	..
300,000	Eastern Extension, Australiasia, and China Telegraph	10	7 %	7 %	7 %	14 — 14½	13⅞— 14⅛	14 1/16	13⅞
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105½—107½	..	..
300,000	Eastern & South African Tele., 4 % Mt. Db., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	100 —102	100½—102½	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	100 —102	100½—102½	..	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5⅛%	5⅜%	10½— 10⅝	10½— 10⅝	10⅝	10½
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14½— 14¾	14½— 14¾	14 13/16	14½
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	33½ — 34½	33 — 34	33⅝	33¼
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	101 —103	101 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	49 — 51	49 — 51	50	49⅜
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	¾— ⅞	¾— ⅞	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	111½—112½	111 —112	111⅝	111
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	102 — 104	102 — 104	103	102⅝
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	12½
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½— 12½	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3⅜%	3½%	100½—102½	101 —103	100½	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103½—105½	105	104⅝
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6⅛%	6⅛%	1⅛— 1⅛	1⅛— 1⅛	1 1/32	1⅛
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 —102	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	7½ — 8	7½ — 8	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	125 —128	125—128	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	7 — 7¼	7 — 7¼	7 1/16	7⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	108 — 110	108 —110	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	8 — 8¼ xd	8¼— 9 xd	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	7/16 — 9/16	7/16 — 9/16	..	..
150,000	West Coast of America, 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	13½— 14½	13½— 14	14	13⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	102 —104	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	7½— 8	8 — 8½	8¼	8 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	5⅜— 6⅛	5⅜— 6⅛	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —106	103 —105	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	2⅜— 3⅛	2⅜— 3⅛	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	100 —104	100 —104	..	..
133,301	British Electric Traction	10	8 %	6 %	..	9⅛— 9⅜	9⅛— 9⅜	9 1/16	9⅛
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	..	11⅛— 11⅜	11⅛— 11⅜	11 1/16	11 1/16
1,000,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	122 —124	122 —124	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	98 —100	97 — 99	98⅜	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5½— 6	5½— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5½— 6	5½— 6	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	103 —106	103 —106	..	..
50,000	¶ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	⅝— 1⅛	⅝— 1⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1 — 1¼	1 — 1¼	1¼	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	94½	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4⅜%	4½%	79 — 82	79 — 82	81	80
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10 — 11	10 — 11	10⅜	10
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅜— 5⅝ xd	5⅜— 5⅝ xd	..	..
300,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	106 —108 xd	106 —108 xd	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	90 — 92	92½	91
523,596	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
523,396	Do. do. Def.	Stock	4 %	4 %	4 %	80 — 83	78 — 81	..	..
1,330,000	City and South London Railway	Stock	3½%	2⅝%	2½%	39 — 41	39 — 41	41	39½
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	..	1⅞— 2⅛	1⅞— 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	95 —100	95 —100	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1¼— 1½	1¼— 1½	1½	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	2 — 2⅛	2 — 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	84 — 89	84 — 89	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	89 — 94	85 — 90	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	¾— 1	¾— 1	..	..
31,590	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	..	2¼— 2½	2¼— 2⅜	..	..
250,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	95 — 98	95 — 98	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅝— 10⅛	9⅝— 10⅛	..	..
200,000	Do. do 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	11½— 12⅛	11⅝— 12⅛	12¼	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15½— 16½ xd	15½— 16½ xd	15½	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —103	100 —103	..	..
37,500	Liverpool Overhead Railway, Ord.	10	1½%	13%	1½%	3⅜— 3½	3⅜— 3½	..	..
10,000	† Do. do. Pref. £10 paid*	10	5 %	5 %	5 %	9⅛— 9½	9⅛— 9⅜	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	32 — 34	32 — 34	33⅜	32
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	103 —105	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3⅛%	2⅛%	3⅛%	90 — 92	90 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations June 21st.	Closing Quotations June 28th.	Business done week ended June 28th, 1905. Highest	Lowest.
29,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	‡ £ 5	8 %	10 %	10 %	9⅜ — 10¼	9⅜ — 10¼	..	..
10,623	Do. do. 7 % Cum. Pref. ..	5	7 %	7 %	7 %	9¼ — 10¼	9¼ — 10¼	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	103 —106	103 —106	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	7¾ — 8	7¾ — 8	7⅞	..
80,000	Do. do. do. 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	..
40,000	Do. do. " City Undertaking " 4½ % Cum. Pref. ..	5	4½%	4½%	4½%	5 — 5¼	5 — 5¼	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	5 — 5¼	5 — 5¼	5 1/16	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	109 —111	105 —107 xd	105	..
44,436	*Chelsea Electricity Supply, Ord.	5	4½%	5⅜%	6 %	6⅛ — 6⅝	6⅛ — 6⅝	..	..
150,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595.. ..	10	5 %	5 %	6 %	10⅜ — 11⅛	10⅜ — 11⅛	11	10⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14¼	13¼ — 14¼	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	5 %	5 %	5 %	124 —128	124 —128	127	..
800,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid ..	100	4½%	4½%	4½%	104 —106	104 —106	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	8¾ — 9	8⅞ — 8⅞	8⅞	8 1/16
30,000	Do. do. do. 6 % Pref., 40,001—60,000 ..	10	6 %	6 %	6 %	12⅝ — 12⅞	12⅝ — 12⅞	12⅝	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	113 —116	113 —116	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	103 —105	103 —105	104	..
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5¾ — 6¼	5¾ — 6¼	6 1/16	5⅞
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	..	6 — 6¼	6 — 6¼	6 1/16	6
300,000‡	Do. do. 4½ % 1st Mort Deb. Stock ..	100	4½%	4½%	4½%	107 —109	107 —109	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	11⅛ — 12⅛	11⅛ — 12⅛	11⅛	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	2 — 2⅛	2 — 2⅛	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..
871,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99 xd	99 —101 xd	100⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8⅜%	10 %	9⅜ — 10⅜	9⅜ — 10	9 15/16	9⅜
76,121	Do. do. 4½ % Cum. Pref. 1—71,106, £3 paid ..	5	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..
220,000‡	Do. do. 4½ % 1st Mort. Deb. Stock ..	..	4½%	4½%	4½%	111 —115	111 —115	..	..
250,000‡	Do. do. 3½ % Mort. Deb. Stock Red. ..	Stock	3½%	3½%	3½%	99 —101	99 —101	98	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	100 —103	101 —103	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14⅜%	13⅜ — 14½	13⅜ — 14½	14	13⅜
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	8¾ — 9	8⅞ — 9	..	..
150,000‡	Do. do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	98 —100	97 — 99	98	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	5	1¾%	3 %	4 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..
100,000	South Metropolitan Electric Light and Power (Ord	1	Nil	Nil	Nil	¼ — ⅜	¼ — ⅜	..	..
50,000	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..
100,000	*Dist. E.L.Co.)* 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	4⅜ — 5	4⅜ — 4⅝	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	5 1/16
200,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	100	..	..	4½%	104 —106	104 —106	105½	105
110,000	Westminster Electric Supply, Ord.	5	12 %	13⅛%	14 %	12⅛ — 13	12⅛ — 13	13	12⅝
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..

Shares not officially quoted :—Mackay Companies, ord., 39⅜—40¼. Pref. 73⅜—74¼.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 28th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-]	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %) ..	per ton	£22	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	147/-	3/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a Sodium Bichromate, casks ..	per lb.	2¾d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10¼d.	..
c ,, ,, (solid drawn) ..	per lb.	10¼d.	..
g Copper Bars (best selected) ..	per ton	£80	..

METALS, &c. *(continued)*.		Latest Price.	Fortnight's Dec. or Inc.
g Copper Sheet	per ton	£80	..
g ,, Rod	per ton	£80	..
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, ,, Sheets ..	per ton	£87	..
e ,, ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¼d.	..
Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/6 to 5/6½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	45/6½	3½d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£13 10 to £13 12 6	5/- inc.
g ,, ,, Sheet	per ton	£15 5	5/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 7 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, ,, rolled bars & rods	per lb.	1/1 to 1/3	..
p ,, ,, strip & sheet	per lb.	1/3	..
o Platinum	per oz.	84/-	1/6 inc.
e Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£140 10 to £141	50/- inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/8	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£43 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£27 7 6	10/- inc.

Quotations supplied by Messrs. :—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons, Ltd.; *d* F. Wiggins & Sons; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Consular Notes from New Orleans (U.S.A.).—Consul Hunt in his report from New Orleans, U.S.A., says that there is a reduction in exports, one of the particular items being electrical plant. He also indicates in his report that "articles of British manufacture of first-rate quality and finish, find a ready sale" there "on account of their marked superiority. The high import duties do not keep out the goods of firms whose names are household words wherever the English language is understood. There is no market for inferior makes." He further says that salesmen there if they wish specially to recommend any article always lay great stress on its having been imported as a sign of its good quality. Among other matters touched upon in Consul Hunt's report, is the installation of a de Forest wireless telegraph station at New Orleans, which will be a great boon to the shipping.

Lambton Collieries.—The LAMBTON COLLIERIES, LTD., of Newcastle-on-Tyne, have, we learn, divided the contracts for the electrical installation between the Electrical Co., of Charing Cross Road, W.C., and Messrs. Bruce Peebles & Co., of Edinburgh. The collieries included in the contracts are:—Burn Moor (D. Pit) and Lady Ann; Lumley; Newbottle (Dorothea and Margaret); and New Herrington, also the Philadelphia Brick and Pipe Works. The whole of the work is to be completed before the close of the present year, as the Lambton Collieries, Ltd., have arranged, commencing with the new year, to take the necessary electrical energy from the Durham Electric Power Co.'s station at Philadelphia.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MAY, 1905.

The fluctuations of our electrical business, at home and abroad, are well illustrated in a comparison of this and the preceding months' returns.

Thus our exports have advanced from a total of £80,229 during April to some £138,414 in May, and whereas they were considerably less in value in the earlier month than the imports, in the later return they are some £16,000 in excess; the imports for the two months being, respectively, (April) £110,728 and (May) £122,353.

The re-exports have remained practically stationary, the May total being £8,512.

Glancing at the detailed table, we may note that the only telegraphic item appearing as such in the returns is a small export of £80 value; that tramway exports reached a total of over £10,000; and that while our machinery exports nearly trebled the previous month's figure, the machinery imports during the same period declined from £38,458 to £29,207.

The exports, in fact, show a great improvement all round, being higher than any of the tabulated returns previously given in these columns; our own Colonies and India are, in great part, responsible for the increased trade.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electric light and power cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	70	20	...	...	...	2,126	18	...	155	337	...
Germany ...	37	...	145	...	...	1,519	...	...	...	...	...
Netherlands ...	133	1,343	365	4	...	82	30	...	...	16	...
Dutch Borneo, Java and Guiana ...	193	...	15	...	13	25	...	...	...	...	...
Belgium ...	44	30	93	25	11	172	1	...	12	...	...
France ...	665	...	114	7	...	406	10	...	...	73	...
French Indo-China ...	46	...	63	...	...	86	...	...	...	...	...
Portugal, Madeira and Portuguese Africa ...	142	7	143	2	43	8,922	520	...	11	459	...
Spain and Canary Isles ...	9	...	5	10	140	3,445	20	...	4	223	...
Italy ...	6	...	4	...	30	323	...	...	21	77	...
Greece ...	...	...	...	...	...	267	...	...	...	...	...
Egypt ...	286	257	71	10	...	123	10	...	574	218	...
China, Siam and Korea ...	314	307	298	68	...	242	11	3	...	28	...
Japan ...	356	7,744	42	135	16	...	...	...	24	...	...
U.S.A. and Cuba ...	4	...	...	3	...	1,739	15	9	...	935	...
Mexico, Peru and Uruguay ...	...	4,964	17	...	3	218	17	...	...	...	...
Chili ...	48	195	425	...	15	107	29	27	...	...	...
Brazil ...	5	...	34	13	155	606	...	...	...	...	...
Argentine ...	437	1,442	549	160	7	5,235	725	...	208	...	...
Channel Isles, Gibraltar and Malta ...	61	19	38	...	...	435	17	...	...	...	...
British West Africa ...	...	11	...	...	...	...	31	...	43	...	...
Cape of Good Hope ...	2,030	5,612	856	64	228	4,727	18	4	2,958	3,714	...
Natal ...	704	1,682	791	621	498	1,197	419	...	1,994	43	435
Zanzibar, Brit. East Africa, Mauritius and Aden	27	...	7	...	51	15	...	...	43	29	...
India ...	6,391	4,897	480	1,100	592	4,035	124	127	695	912	7,426
Burmah ...	11	...	437	37	...	45	7	...	...	...	...
Ceylon ...	2	94	92	28	5	237	...	...	30	63	...
Straits Settlements and Labuan ...	209	193	182	158	47	788	...	8	...	7	2,500
Hong Kong ...	321	...	...	...	...	40	...	...	...	...	...
West Australia ...	552	403	204	59	695	4,341	44	...	96	153	...
South Australia ...	89	20	67	...	...	4,707	15	...	88	...	...
Victoria ...	371	347	26	...	206	306	...	...	1,750	500	...
New South Wales ...	1,242	260	184	614	...	2,103	57	4	78	57	...
Queensland ...	33	345	11	...	...	60	...	4	...	8	...
Tasmania ...	...	...	...	...	322	...	5	...	...	...	...
New Zealand and Fiji ...	732	576	344	87	58	465	459	18	72	15	...
Canada ...	...	...	64	...	...	...	...	...	...	...	...
British West Indies and British Guiana ...	34	...	...	...	...	50	11	...	...	...	...
Total, £	15,804	30,768	6,166	3,185	3,335	49,195	2,593	204	8,856	7,867	10,361

Telegraph Exports for month, U.S.A., wireless telegraph apparatus, £80.

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark ...	201	...	...	100	...	2,031	66	...	18,235	...	...
Holland ...	8,715	366	111	40	...	1,529	...	4,389	...	...	...
Germany ...	5,155	9,144	1,827	398	3	9,697	1,157	640	1,619	...	...
Belgium ...	9,184	576	485	154	...	3,160	31	1,221	1,414	...	...
France ...	8,441	1,201	358	63	947	1,214	921	2,408	1,595	...	...
United States ...	7,408	535	704	2,293	329	11,576	15	20	43	309	...
Canada ...	...	...	...	...	...	...	...	200	...	820	...
Total, £	39,104	11,822	3,485	3,048	1,279	29,207	1,490	8,878	22,906	1,129	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above.	1,417	219	227	...	7	3,354	96	61	3,093	...	...

TOTAL EXPORTS: £138,414.

TOTAL RE-EXPORTS: £8,512.

TOTAL IMPORTS: £122,353.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

SINGLE-PHASE LOCOMOTIVE FOR HEAVY RAILWAY SERVICE.

Of the many interesting exhibits of railway appliances prepared for the inspection of the delegates to the International Railway Congress, probably the most novel, and certainly the most important in its bearing on the use of electricity as a motive power for heavy railroad service, was the Westinghouse-Baldwin single-phase alternating-current locomotive shown in operation on May 16th on the Interworks Railway at East Pittsburg. This locomotive was built by the Westinghouse Electric and Manufacturing Co. in order to convince the railway managers of the world of the possibilities and advantages of the use of single-phase current for heavy electric traction, and to demonstrate in the most convincing manner possible, the ability of the company to supply the necessary apparatus. It was shown in operation first running light, and then hauling a train of 50 new steel gondola cars, weighing approximately 1,200 tons.

From the various details which are given below, it will be seen that a number of new features are embodied in the construction of this locomotive, and claims of priority are made for it in a number of respects. It is, for instance, the largest alternating current locomotive in the world, the largest to be operated by single-phase current, and it is equipped with six of the largest single-phase series motors ever built. It is the first alternating-current locomotive for use in America, and is designed for the highest trolley voltage ever used in that country. This locomotive is also the largest ever operated by means of overhead trolleys, is the first on which forced ventilation is used in the motors, and is unique in other ways.

The weight of the locomotive complete is 135 tons. It is built in halves, each having one six-wheel truck with rigid wheel base. These are coupled together and are intended to operate normally as a single unit, but each half may be operated separately if desired. The locomotive is approximately 45 ft. long over all, and 9 ft. 8 in. wide. The total height above the rail with trolleys lowered is 17 ft. The wheels are 60 in. in diameter, and are mounted on 8-in. axles, with 6 ft. 4 in. between centres. The side frames of the truck are of cast-steel, and are spring supported in the usual manner, the weight on the two inside axles of each truck being equalised. The cabs are built of sheet steel with angle iron supports, and the cab as a whole is removable from the truck.

Each axle carries a 225-H.P. single-phase series motor with single reduction gearing, making a total of six motors for the locomotive. One side of each motor is supported directly on the axle, and the other is suspended by spiral springs from the locomotive body. The motors are of the same general construction as the standard Westinghouse A.C. railway motors of smaller size. They are so arranged that forced ventilation may be used, and increased output thus secured.

The locomotive is designed for a frequency of 25 cycles per second, and a trolley voltage of 6,600 volts, and one of the most striking points of the exhibition to those who have been accustomed to the enormous currents required in heavy direct current traction work, was the sight of so large a locomotive accelerating a 1,200-ton train over a third of a mile in length and receiving its entire power supply from a single No. 000 trolley wire.

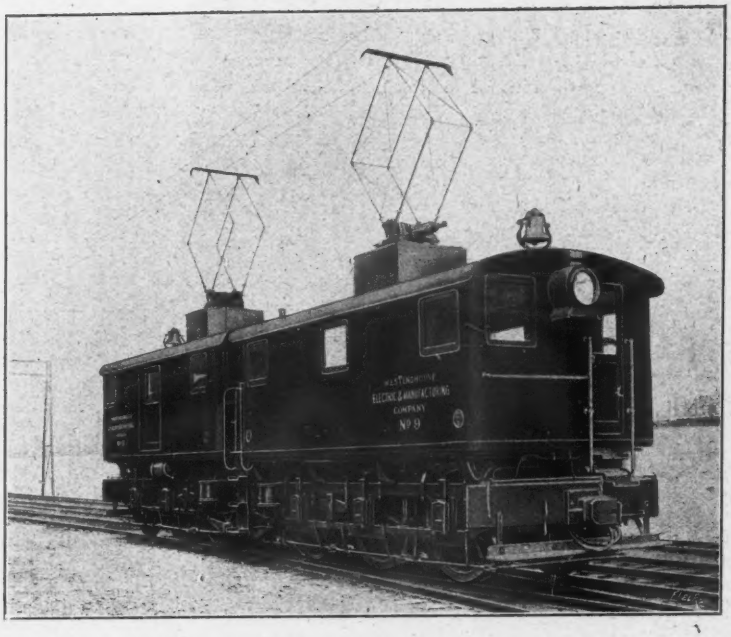
The 6 600-volt current is collected from the trolley wire by a pneumatically-operated pantograph trolley on each half of the locomotive, and is carried through a suitable oil switch and circuit-breaker to an auto-transformer in each cab. These transformers reduce the voltage to 325 for use at the motors. The trolleys may be raised or lowered from the cab by a suitable air valve.

The three motors on each half of the locomotive are connected permanently in parallel, and are controlled by means of an induction regulator, which, at the will of the operator, varies the voltage at the motors from about 140 to 325. The induction regulators are driven by small series motors of the same general type as the main motors. Both regulators are controlled by the multiple unit system from a master switch at either end. They may be stopped at any desired point in their travel, and thus the locomotive may be run at any speed with the same facility and economy as a steam locomotive.

Forced ventilation is used with the auto-transformers and induction regulators, as well as with the motors, the necessary air being supplied by suitable motor-driven blowers. Motor-driven air compressors are also used.

The locomotive is designed for low-speed freight service, this type having been chosen because the design of series alternating-current motors for very low-speed service presents many more problems, and is much more difficult than the design of equal capacities for the ordinary conditions. This problem having been solved, the production of similar locomotives for passenger service becomes a relatively simple matter. With the motors working at nominal full load output, the locomotive will develop a drawbar pull of 50,000 lb. at a speed of approximately 10 miles per hour. On several occasions, however, when hauling the 50-car train referred to above, steady drawbar pulls of from 60,000 to 65,000 lb. have been recorded on the dynamometer car, and momentary efforts as high as 100,000 have been obtained with no sign of slipping of the wheels. With lighter loads, the locomotive may be run at higher speeds up to a maximum of about 30 miles per hour.

The successful completion of so large and powerful an alternating current locomotive without the usual series of developments through gradually increasing sizes, which is ordinarily required when so great a problem is undertaken, marks a distinct advance in the production of electrical apparatus for heavy traction work, and, now that the first important step has been taken, should materially accelerate the use of electric traction on main line railways, which has so long been looked for.



Westinghouse-Baldwin Single-Phase Locomotive.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

The tenth annual conference of the Incorporated Municipal Electrical Association, which has been held this week in Edinburgh, was opened last Tuesday, the 27th, in the orthodox way by the reading of the presidential address.

The President this year is Mr. F. A. Newington, chief electrical engineer to the Edinburgh Municipality.

It cannot, without stretching the bounds of courtesy beyond the limits of truthfulness, be said that the address will rank as an epoch-marking event; its chief interest lies in the fact that many of the arguments used may be regarded as against, rather than for, municipal electrical undertakings.

Touching, first, upon the vexed question of depreciation, Mr. Newington said that the Association had "come to the conclusion that about 30 years is the average life of electrical plant," and, upon the strength of this *ex cathedra* pronouncement, argued that if municipal loans were paid off in 25 or 30 years, and the reserve fund made up to the full amount—viz., 10 per cent. of the capital expended—there was no necessity for a depreciation fund.

The author puts it that if at the end of 25 years the machinery has been kept in good order by general maintenance and by calling upon the reserve fund in special cases, our successors will inherit a good business, free of all cost, and the loan being paid off, "they will be at liberty to borrow again to replace machinery if necessary."

We interpret the words "kept in good order," to mean that the plant at the end of 25 or 30 years is practically as good as new, that armatures, commutators, brush-gear, magnet coils and bearings have been renewed. .

But if the machinery has been kept in good order, why replace it at all? The fact is that while this kind of argument is based on the hypothesis that the life of electrical plant is 30 years, and that it can be kept in good order during this time "by general maintenance" (and so last for ever), the very people who advance it—not from genuine conviction, but from a wish to believe—these men, being practical station engineers, know from experience that machinery must from time to time be replaced with more modern plant. Obsolescence must be taken into account.

Mr. Newington recognises this, and knows what a poor game it is to sell second-hand machines. He points out that the small units frequently put down at the start of an electricity supply undertaking are, "after a few years,"—not 25 to 30 years—found to be inconvenient to work and have to be sold at scrap value. This depreciation in value, it is admitted, can only be properly met by a depreciation fund.

Incidentally, the author's arguments against the necessity for a depreciation fund illustrate forcibly the unfair conditions under which companies, with statutory powers, work.

He shows that a company possessing powers to supply electricity in a given area are bound to sell to the municipality within 42 years, if the municipality desire to purchase. The company, it is pointed out, can claim nothing for goodwill, but must accept simply the then value of the plant, commonly understood as the "scrap" value. Hence the need for a depreciation fund. Municipalities do not work under these conditions, the statutory powers having no time limit, and the only restriction being that borrowed capital must be repaid in 25 to 30 years. At the end of that time, says Mr. Newington, "buildings will still be quite good; the copper in the mains will be of very considerable value," and the machinery, it is claimed, will be in good condition, having been kept up "by general maintenance." And if the municipality then wished to sell out to a company, "they would," says the author, "be able to command a very considerable sum for goodwill." Having got this very considerable sum for goodwill, and a fair value for the plant, the municipality would be able to force the company to sell the undertaking back again to them, at the end of the time limit, at scrap value.

Well might Mr. Newington say: "It seems, therefore, that local authorities are very much better situated in this respect than companies." What the business man, who is not enthusiastic on the subject of municipal trading, would like to know is, why should a municipality possess such an advantage, and, possessing it, why the results of municipal trading show to such disadvantage in comparison with company working?

The methods of dealing with the profits of municipal electricity undertakings (when there are any) are referred to in the address, and the remarks on this head serve to emphasise again the almost insuperable difficulties in the way of a municipality carrying on satisfactorily and equitably a business in a commodity which is not a universal need.

Fresh air and water are necessary to every man, and no one objects to municipally controlled water services, the provision of open air spaces, and proper sanitation. Electric light and trams are not necessaries of life, and, as Mr. Newington very rightly points out, it is an act of injustice that the users of electric light should be compelled to help the users of gas to pay their rates, which is, of course, what happens when any profits from an electricity undertaking are handed over to relieve the general rates. The speaker appeared to think that justice would be met if equal amounts were contributed to the rates from both the gas and electricity undertakings. But this does not remedy the evil at all, it simply penalises two sections instead of one—the gas users and the electricity users—for the benefit of the general body of ratepayers.

"If electricity were universally used," says Mr. Newington, with a fine disregard for the niceties of the subjunctive mood, "a contribution to the rates, though undesirable, would then be borne more evenly than under present conditions."

A tramway undertaking is in almost the same position, for whilst there may be no direct competition—unless omnibus and cab services can be so regarded—trams are not used by the whole population; and any contribution paid to the rates out of profits on the tramways is, points out the President of the M.E.A., an unfair tax on the poorer part of the population, who make use of the trams, for the benefit of the rich.

It is surely by a strange freak of irony that a president of an association of municipal officers met in conference to discuss and advocate municipal undertakings, should be thus compelled to advance arguments which, whatever their intent, contain a bitter impeachment of municipal trading generally, but trading more particularly in the very undertakings in which every member of the Association is vitally interested, viz., electricity supply for lighting, power or tramways.

Theoretically, it is improper for a municipality to show any profit on an electricity undertaking. Any surplus on such trading should be used to improve or cheapen the service, so that the users or consumers, from whom alone the revenue is derived, secure the benefit.

But a Council would be more than human, judged by the standard of humanity of to-day, if, with a deficit on the general rates, they hesitated to appropriate a profit from the electricity department to pay the debts of the general public. Nor, on the other hand, have they the least compunction, when a loss is shown, in making the general public bear this loss. If the ratepayers had it in their power to refuse to pay that portion of the rates which is devoted to subsidising municipal trading, very few new municipal electricity works would be started, and a good many existing ones would be for sale.

When "passive resisters" have grown tired of resisting the payment of the Education rate, they might do worse than direct their attention to the rates due to losses on municipal trading. Loss, or profit, it is difficult, if not impossible, to justify it; because, under the best conditions, as is so clearly demonstrated in the address referred to, an act of injustice is done to some section or other of the ratepayers; and private enterprise, upon which the national character depends, is discouraged and crippled.

House wiring is another point touched upon in the address, and it is pointed out that very little improvement has been made in this direction during the last 10 or 12 years. India-rubber insulation on cables contains from 50 to 60 per cent. of something that is not rubber, and, generally speaking, the insulating materials used are not nearly so good as they were 10 years ago. The present tendency to supersede wood casing by iron pipe work calls for a better not a worse insulating covering on the wires, and if this demand cannot be met by india-rubber a substitute will need to be found.

We cannot agree with the President's suggestion that house wiring should be undertaken by municipalities—we spoke strongly against this proposal in our leader of a few weeks ago; nor are we at all satisfied that municipal engineers should have powers to enforce wiring regulations, particularly if those wiring regulations are drawn up by themselves.

If one standard set of wiring rules be adopted—say the rules of the Institution of Electrical Engineers, with any *necessary* amplification to meet local conditions; and if installations be inspected and passed by some one who really knows good work when he sees it, and who has no special bias towards a particular make of goods, it is possible that very little objection would be raised. But those contractors whose work takes them into various parts of the country, and who have, therefore, had a foretaste of what such inspections would mean, will look with some alarm upon the proposal of the Council of the M.E.A. to obtain the sanction of the Board of Trade to make and enforce wiring rules. It is a proposal that needs to be carefully watched in order that the interests of both manufacturers and contractors should be safeguarded.

We yield to none in our desire to promote the spread of all branches of the electrical industry, and good work well done is the best guarantee of true progress; but, remembering the harm done in the past by vexatious and unnecessary restrictions, we view with some suspicion all measures which, if not conceived on broad and liberal lines, may tend rather to retard than to advance the healthy development of electrical enterprise.

THE MUNICIPAL POWER DILEMMA.

Can anything good in the way of counsel to Municipal Electrical Committees come out of Salford? A few days ago we should have been very sceptical as to the usefulness of any offers of guidance in station management from a councillor of the town whose own experiences of municipal trading in electricity have been so disastrous. And truly it is difficult to start seriously on the consideration of an address intended for the edification of the Municipal Electrical Association, and entitled "The Supply of Electricity in Industrial Areas from a Municipal Point of View," when we read immediately below, "by Councillor William Hodgson, Deputy-Chairman of Salford Corporation Electricity Committee." If, however, we go further and consent to take our stand by Mr. Hodgson's side at "the municipal point of view," we find much interest in this gentleman's speculations, and much to commend in his transparent controversial honesty, though he may, like many other municipal debaters, shrink from the logical conclusion of his own premises.

To summarise the purpose of the address, it is apparently recognised by the author that the enterprise of the electric power companies is threatening to throw into more and more glaring exposure the general failure of municipal electrical undertakings to keep pace with the demand for the advantageous applications of the product of which they retain a jealous monopoly. Mr. Hodgson has made the rather belated discovery that "the near future will demand a supply of cheap electric power," and he has the courage to call this a "new and unforeseen condition of things" which is likely to cause serious embarrassment to municipal committees. Here, if one were needed, is another example of that blind complacency which is partly responsible for the funereal progress of municipal "enterprise." For the coming of cheap electric power was largely discussed before 1900, when the first Power Bills were passed. Municipalities should then have bestirred themselves to meet that demand, but they chose rather merely to oppose the Power Bills in order to protect their weakling electric lighting business. Not until now, when the companies are supplying cheap power at their very gates, do we hear Councillor Hodgson, of Salford, uttering his bold prediction of the demand for cheap power in "the near future," which is a "new and unforeseen condition," five or six years after Power Bill promoters first set forth to deal with the then obvious demand. It is apparently, indeed, Councillor Hodgson's amazement at finding that "in the neighbourhood of Manchester contracts are being made by a power company at prices varying between ½d. and ¾d. per unit" which has inspired his whole address.

Being, as we have said, an honest controversialist, Mr. Hodgson answers the question why municipalities have not yet been in a position to offer the same low rates as the power companies, by some frank admissions. He confesses that "they have not realised the possibilities of power supply on a large scale, and are, consequently, not prepared for it"; and again, that "they have hitherto hesitated to lay out the large sums of money required for adequately dealing with the problem." In other words, the deputy-chairman of the Salford Electricity Committee accuses the municipal traders of ignorance of their business and lack of enterprise; which are, of course, the perennial and inevitable disadvantages of all commercial monopolies supported by the public credit and managed by elective bodies.

It is to his credit that the Councillor should see trouble looming ahead. He recognises that the existence of a supply of cheap power outside the areas of the debilitated municipal monopolies may soon produce one of two results, both unpleasant for his contemplation. Either the cheap power company will be given the right to enter the towns and compete, or the power users will evacuate such towns. In the former case, the municipal electrical undertaking will become a "back number"; in the latter case, the prosperity of the town, as a whole, will be seriously jeopardised. Mr. Hodgson seems to doubt that the municipalities will adopt a purely defensive attitude, relying on the inviolate permanence of their present exclusive authority "to maintain the present comparatively high price of current, with its tendency to discourage large consumers and so render further extensions unnecessary, or, in other words, contribute to their own extinction." He shows clearly that, unless they are resolved to march forward with the times and provide cheap power themselves, they must, gracefully or ungracefully, surrender their monopolies, so that manufacturers shall not be debarred from the use of this agent of more economical production. Mr. Hodgson appears confident that the larger towns, at any rate, will rise to the occasion, and will try to imitate the power companies, whose aims and achievements they are now at last beginning to understand and respect. For our own part, we prefer to believe that the economic tendency is for the isolated town undertakings either to be bodily swallowed by the power companies, or to become merely distributors of electricity for certain limited purposes. In a unified scheme they will compare as local branch lines with the main line business of the power company that governs the whole area.

LOAD-FACTOR: ITS EFFECT ON AN ELECTRICITY STATION.

It is always a matter of gratification to be able to record the evidence of sympathy with, and understanding of, the technical side of an electric light and power undertaking on the part of the officers of a Municipal Committee. Such evidence is afforded in the paper on the above subject read by Councillor Alex. Sinclair, the Chairman of the Swansea Electric Lighting and Tramways Co., at the Annual Convention of the Municipal Electrical Association at Edinburgh. Hasty generalisation is the stumbling-block at many a Borough Council meeting, and careful analysis along lines not only commercial but technical, such as is shown in this paper would, if more generally applied, prove a panacea for many of the troubles that arise between Councillors and their engineering staff. The paper was admittedly read for the benefit of chairmen and members of Electricity Committees, but at the same time is not without interest to the engineer.

The types of custom producing a good load-factor were enumerated as public lighting; power and heating; tramways; supply in bulk; and the lighting of small cottages. The effect on load-factor of the first three items was carefully considered, their effect being shown in the form of average daily load curves for a typical town of 100,000 to 150,000 inhabitants, and a station of 1,500 to 2,000 KW. capacity. For private lighting a chart was given showing a night-and-morning load of roughly 50 KW. till 4.30 p.m., a peak rising to 700 KW. and falling to 200 KW. by 6.30, after which the decline is gradual. This seems a fairly representative curve (the winter peak being probably much heavier than this average value) and accounts for 613,200 units per annum. The station load factor works out at 10 per cent. It was pointed out that adding to lighting consumers may not improve the load factor, but may increase the discrepancy between the peak and the hollows. Next came a chart of public lighting supply of 219,000 units annual output, the maximum demand being 50 KW., giving a load factor of 50 per cent. A power curve (motor load) lasting from 5 a.m. to 7 p.m., for a supply of 459,000 units with a maximum of 125 KW. (load factor being 42 per cent.); and a traction load curve (5 a.m. to 1 a.m.) for a supply of 916,370 units with a maximum of 225 KW. and power factor 47 per cent. were also given. Then the first three curves were superposed, which, for 1,281,200 units per annum and maximum demand of 875 KW., gave a load factor of 16·71 per cent. On adding traction to this the units per annum become 2,207,570, the maximum load 1,100 KW. and the load factor 23·14 per cent.

The effect on cost per unit of different load factors was next illustrated by a series of curves, the first showing works costs only (being, for example, 1·325d. per unit at 10 per cent. factor, 0·795d. at 20 per cent., 0·560d. at 40 per cent., and 0·465d. at 60 per cent.), the next being the above costs plus management, rent, rates, taxes, insurance, &c. (1·870d. at 10 per cent., 1·180d. at 20 per cent., 0·830d. at 40 per cent., and 0·650d. at 60 per cent.), and the third

being these total costs plus interest and sinking fund, an average capital expenditure of £120 per kilowatt of maximum demand, and 5¼ per cent. for interest and sinking fund being assumed. Figures from this curve are 3·595d. at 10 per cent., 2·040d. at 20 per cent., 1·258d. at 40 per cent., and 0·937d. at 60 per cent. In order to extend the usefulness of such curves, a table giving the cost per unit with varying capital charges per kilowatt maximum demand was prepared. From this we find that the interest and sinking fund at 5¼ per cent. calculated on cost per kilowatt of maximum demand, plus the total of works costs, management, rents, &c., are, for a 10 per cent. load factor, 3·02d., 3·308d. and 3·883d. for £80, £100 and £140 per KW. of maximum demand, the corresponding figures for 20 per cent. load factor being 1·752d., 1·896d. and 2·184d.; for 40 per cent., 1·116d., 1·187d. and 1·33d.; while for 60 per cent. they are 0·839d., 0·887d. and 0·995d. These are comparable with the figures above given for £120 per KW. Councillor Sinclair has checked the figures of his curves by actual costs per unit obtained at various stations, as shown in the subjoined table :—

Place.	Units.	Load factor.	Actual.			Curves.		
			Works.	Management, rent, &c.	Total.	Works.	Management, rent, &c.	Total.
		%	d.	d.	d.	d.	d.	d.
Colwyn Bay	145,406	7·33	1·77	0·71	2·48	1·95	0·75	2·70
Hereford ...	108,851	8·45	1·39	0·81	2·20	1·61	0·59	2·20
Llandudno	336,936	8·41	1·47	0·69	2·16	1·61	0.59	2·20
Leicester ...	1,719,001	9·64	1·24	0·59	1·79	1·36	0·56	1·92
Luton ...	160,844	9·90	1·12	0·74	1·86	1·33	0·55	1·88
Longton ...	61,747	10·19	1·45	0·38	1·83	1·31	0·54	1·85
Lancaster ...	604,948	10·20	1·30	0·51	1·81	1·31	0·54	1·85
Darlington	266,311	10·87	1·04	0·79	1·83	1·25	0·53	1·78
Lincoln ..	399,797	12·24	1·09	0·51	1·60	1·14	0·50	1·64
Birmingham	4,967,164	12·25	1·33	0·51	1·74	1·14	0·50	1·64
Birkenhead	661,171	13·30	1·13	0·46	1·59	1·07	0·48	1·55
Derby ...	1,490,611	13·58	1·11	0·35	1·45	1·06	0·47	1·53
Burton ...	678,020	14·42	1·15	0·38	1·53	1·01	0·46	1·47
Cheltenham	1,534,144	14·95	1·05	0·42	1·47	0·99	0·45	1·44
Newport ...	1,572,362	15·30	1·10	0·21	1·31	0·98	0·44	1·42
Swansea ...	871,555	15·81	0·98	0·38	1·36	0·96	0·43	1·39
Cardiff ...	2,385,472	15·85	1·11	0·30	1·41	0·96	0·43	1·39
Leyton ...	1,194,944	15·93	1·02	0·40	1·42	0·96	0·42	1·38
Bury ...	671,911	16·26	0·92	0·38	1·30	0·94	0·42	1·36
Govan ...	894,702	17·03	1·02	0·42	1·44	0·92	0·41	1·33
Sunderland	3,508,139	19·21	0·92	0·38	1·30	0·82	0·39	1·21
Devonport	1,349,645	20·46	0·87	0·22	1·09	0·78	0·38	1·16
Greenock	1,413,783	20·27	0·86	0·38	1·24	0·79	0·38	1·17
Ayr ...	1,047,781	22·55	0·99	0·30	1·29	0·74	0·37	1·11
Bootle ...	1,785,486	24·97	0·72	0·18	0·90	0·70	0·35	1·05
Motherwell	724,279	27·06	0·64	0·24	0·88	0·68	0·34	1·02

It is seen that the figures given by the curves tally fairly well with those obtained in actual modern practice.

The importance of increasing the load factor of the station by every possible means being demonstrated by these curves, Councillor Sinclair reviewed the means available for pushing business. Systematic canvassing by attractive booklet or other means of probable consumers of electricity for ordinary lighting was advised. Public lighting should be encouraged by a low charge per unit, the improvement of the financial position of the station being typified by the results at Edinburgh and Glasgow. The supply of power on a large scale to small users at cheap rates, in conjunction with a motor hire system, has been found at Swansea to increase the station load factor from 12 per cent. to nearly 18 per cent. in two years. Timber yards, printing establishments, machine shops, and other places using isolated steam or gas plants, can be readily induced to make a trial of electric motor driving, provided that their liability may end with the year if they desire it. A traction load is obviously of much assistance in decreasing the cost per unit, but Councillor Sinclair wisely refrained from discussing the wisdom or otherwise of operation from a combined station.

The study of load factor would be incomplete without an inquiry as to the amount chargeable to the individual consumer for his participation in the determination of the load factor. As Councillor Sinclair pointed out, if 24 persons could be induced to take each 1 unit per day, consecutively hour by hour, their collective load factor would be 100 per cent., whereas if they all took energy together during one hour their load factor would be 4·7 per cent., the financial result being 24 units at about ¾d. per unit in the first case and 6d. per unit in the second. Hence electricity cannot be purveyed like milk or sugar at so much per quart or pound, its price depending on the quantity required and the load factor of the supply. The maximum demand system, though meeting the requirements of the lighting load, is beyond the range of understanding of the ordinary individual. Councillor Sinclair yearned for "a system simple in itself . . . whereby a customer's load factor could be readily and easily ascertained; his charge per unit could then be regulated by a discount on its rated price."

With this aspiration we must confess to a large amount of sympathy. Although it is admitted that the Wright system gives a good approximation to scientific rating for pure lighting loads, yet the enormous debating power per canvasser required, added to the extra cost of the demand meter, goes far to condone the inaccuracy of a simpler system. If the load-factor of each energy-consuming plant, expressed as the percentage ratio of units actually used in a certain time to those which would be taken if the whole of such installation (lamps, motors, &c.) were used continuously at normal full load for the same period, were taken as the basis of a rebate, the whole reasonableness of the sliding scale would be obvious to an ordinary business man, and would probably have the effect of cutting down non-essential short-hour lamps in an installation, with the beneficent result to the supply system of reducing the cost of copper in the network, whose current-carrying capacity must, of course, be capable of dealing with the maximum load that may reasonably be supposed to occur for however short a time.

There is such evidence in the paper read by Councillor Sinclair of co-operation between the engineering staff and the Committee of the Swansea undertaking that we are encouraged to hope for a generally improved basis of understanding between the technical and executive officers of our municipal electricity undertakings as the science of electricity supply becomes more generally understood.

EXTERNAL CAUSES OF SPARKING IN DIRECT-CURRENT MACHINERY.

By SYDNEY WOODFIELD.

THE following article deals with the sparking in direct-current machinery, due to external causes, that is to say, due in no way to defective design. As a rule, a small amount of sparking for a short time is not detrimental, but owing to the roughening caused to the commutator the effect is cumulative, and it becomes, therefore, necessary to eliminate the cause of the sparking as soon as possible. White sparks are generally small incandescent particles of carbon torn from the brushes by a rough commutator, while bluish-green sparks indicate that damage is being done to the commutator segments. In railway motors, owing to their reversibility, the brushes must be fixed permanently at the neutral point, and the field cannot be utilised for reversing the current in the short-circuited coil; the commutation is, therefore, hardly ever sparkless at full rated load, and the commutator needs considerably more attention than is required for an ordinary uni-directional motor. It has been found that hard crystalline brushes (which have a lower contact resistance and lower coefficient of friction), soaked in hot liquid vaseline, give excellent results.

The following are the more common causes of sparking: —(1) Dirty commutator; (2) Weak field; (3) Excessive overload; (4) Vibration; (5) Incorrect location of brushes; (6) Unbalanced magnetic circuit; (7) Defective commutator or armature.

1. This is, perhaps, one of the most common causes of sparking troubles, and is generally due to the oil wells being allowed to overflow. The carbonised oil, with probably steel dust from the bearings, copper dust from the commutator and carbon from the brushes, forms a plastic mass which makes sparkless commutation impossible. Moreover, it forms a conducting medium between commutator bars,

which can readily be seen by a number of sparks between bars. Finally, this conducting medium will form a short circuit from positive to negative brush. This dirty condition will also cause considerable heating of the brushes and commutator, and the heating may rise to such an extent as to cause damage to the insulation of the machine. In larger machines operated by cross compound engines, oil on the generator is fairly general, owing to the splash from the eccentrics; great care should therefore be paid to the oil guards, which require to be of solid construction owing to the suction caused by modern methods of ventilating armatures. To remove the oil, &c., the commutator should be cleaned with a rag soaked in benzine, and afterwards wiped over with a clean dry rag, a little vaseline being used for lubrication.

In a new machine, after the brushes have been bedded down by drawing a piece of sandpaper backwards and forwards face upwards between the commutator and the brushes, the commutator should be cleaned up with a clean rag dipped in paraffin, until it no longer picks up further carbon dust, and then thoroughly wiped over with a clean dry rag. It is always advisable to run a new machine without load for some time, in order to allow the brushes to wear down and make good contact, as good commutation cannot be expected unless at least 75 to 80 per cent. of the brush surface is in contact. Sparking may also be caused by the brushes not sliding freely in the boxes. If the sides of the brushes are rough, they should be sandpapered, and the inside of the boxes should be wiped out with benzine to prevent sticking. The brush-holders should be staggered on the studs so as not to wear grooves in the commutator. In rotary converters, an end-play device is usually supplied, which constantly oscillates the armature backwards and forwards. The Bullock Co., in their engine type generators, provide a mechanism for slowly carrying the whole brush rigging on trunnions backwards and forwards lengthwise on the commutator to prevent grooves forming. This also prevents any particular spot from aggravating the same brush or brushes, and it is usually found that the movement of the brushes removes the spot that causes the trouble.

Care should also be taken to see that the springs bear on the centre line of the brushes, and that all the brush tips are in a straight line. It may sometimes happen that sparkless commutation cannot be obtained in any location. Alternate brushes on each stud should, if possible, be set about one bar in advance (this is equivalent to increasing the width of the brushes); sparkless running will then generally be obtained. Most modern machines have two or more brushes per stud, which can move independently. In some of the earlier machines only one brush per stud was provided, and, consequently, the slightest irregularity would cause excessive sparking.

2. A weak field is often caused in a new machine by one of the field spools being reversed; this will cause bad sparking. The polarity may be tested with a compass needle, or, if this is not handy, a small piece of iron may be held across the tips of adjacent poles; when these are of opposite polarity, the iron will be held strongly and will take considerable force to remove it, whereas, if they are of the same polarity, the pull will be almost negligible.

Akin to the above is connecting the series winding in opposition to the shunt winding; in a generator this may easily be detected by the fall in pressure as the load comes on. This fall will be considerably more than if the machine were a purely shunt wound one, whereas if the winding were connected correctly, the voltage would, of course, rise. In a motor which is designed to be similarly wound, the speed will rise if the series winding is connected in the reverse direction, whereas if it is connected to act with the shunt field, the speed will drop more than on a shunt motor. In a differentially wound motor the speed should remain practically constant for all loads.

An internal short circuit in one of the field spools will also cause a weakened field, since a portion of the turns are cut out; this will generally be detected by that particular spool being cooler than the rest, or by taking the potential drop across each spool by means of a voltmeter. The drop across the defective spool will be less than across the others. It is obvious that owing to the unequal field strengths under different poles, sparking will ensue. Sometimes the connectors between spools are not properly tightened up, and vibration causes the wire to fall out, thus breaking the field circuit and causing considerable damage. The screws should be firmly driven and a spot of solder dropped on to prevent them from becoming slack. Many motors have to run on grounded circuits; care should, therefore, be taken with the insulation, especially between the shunt and series winding, since it has to stand the full voltage of the circuit at starting.

Unequal field strength under the poles may also be caused by not bolting up the poles or pole shoes tightly; this fault, however, will usually be found when centring up the armature, but all joint surfaces should be carefully cleaned and, except in the case of electrical ones, coated with a thin layer of oil, special care being taken with the pole-pieces and halves of the magnet frame.

Low applied voltage in the case of a motor will cause sparking if the drop in voltage is serious; moreover, as the makers usually have only one field winding for fairly wide limits, rating the speed up or down about half-way in proportion to the increase or decrease (as low voltage on fields tends to increase the speed and on armature to decrease the speed, and *vice versâ*) in voltage, it often happens that one may get as much as 20 per cent. low voltage on the machine and at the same time expect to get full rated load from it without sparking.

In a generator the poor regulation of the governor causing a falling off in speed, gives a lower voltage, and consequently a lower density in the air-gap; this, as above, causes sparking owing to the neutral point shifting.

Shunting the fields of series-wound motors so as to give a higher speed is now rarely used, although it was quite common with railway motors at one time, but considerable sparking was caused by its use when going up hill, for which purpose it was never intended. On a grounded circuit a short-circuit to ground of one of the field spools will weaken the field; this fault is quickly located if the grounded coil is near the line side, as the spools in circuit will get excessively hot; if near the earth side, the same test as for a shorted coil should be applied.

3. Excessive overload on a machine, whether generator or motor, will cause sparking. As is well known, the coil under commutation must be in a field of such strength as to generate an E.M.F. equal in value but opposite in direction to the E.M.F. of self-induction produced by the reversal of current in the coil. As a larger current is drawn from the machine, it is clear that a more intense field is required, but this larger current produces an armature flux which distorts the field and makes it lead the brush position, and at the same time it also weakens the field, hence the brushes must be given a further lead until ultimately a current will be reached such that sparkless commutation is impossible. Modern machines allow considerable latitude in the location of the brushes for a definite load; hence, under normal conditions, the brushes are set fairly well forward, so that when an overload comes on there will be very little sparking, but should the overload still be increased, it will be impossible to prevent it. Care must be taken, however, to guard against too much forward lead, since, should, the station circuit-breakers open, the machine would spark badly at no load, or might even flash over.

The current density in carbon brushes should not exceed 30 amperes per sq. in. at full load, and the tension about 2 lb. per sq. in.: a greater pressure will cause a considerable increase in brush friction, and consequently heating, besides undue wear on brushes and commutator; it furthermore leads to glowing and selective commutation. A heavy overload or short circuit on a shunt-wound generator or motor obviously acts as a low-resistance shunt to the field-winding, and, therefore, the machine loses its field. In a generator, this will automatically relieve the machine, but in a motor, if not efficiently protected, it would result in a burnt-out armature. Care should be exercised in selecting a motor for certain machine tools, &c. Wherever the load is at all intermittent, a compound-wound motor is preferable; for instance, circular saws, pumps of the bucket type, air and ammonia compressors, &c., as if a shunt machine is used there is sure to be trouble from sparking. This matter is, however, governed somewhat by the design of machine, and the material of the magnetic circuit; a material possessing great coercive force is, perhaps, preferable.

4. Vibration is more frequent with small machines, and, in any case, it is detrimental to the proper operation of any plant. In direct-connected sets it is usually due to unbalancing of the engine, knocking of the big ends, badly designed foundations or footings, &c. The cause of the vibration should be immediately localised, as it will cause sparking and a general deterioration of the plant. In belted machines an unbalanced armature or pulley will cause trouble, but more often the cause will be found in a bad joint in the belt, which will cause a considerable amount of sparking every time the joint passes over the pulley. Belts should, therefore, be dressed smooth, and should be run with, not against the lapping; this will effectually stop jarring. The crowns of driving and driven pulley should be alike, as otherwise wobbling of the belt will result. A back and forth movement, due to unequal stretching of the edges of the belt, will also tend towards vibration.

5. Usually the makers of machines mark the correct position of the brushes on the yoke, and unless the machine is operating under abnormal conditions, this location should not be departed from. Under normal conditions in multipolar machines the brushes should be set exactly equidistant around the commutator and parallel to the segments, and the brush boxes should be exactly the same distance from the surface of the commutator. It sometimes happens—but very rarely—that better commutation can be obtained by setting each brush stud individually; this is generally caused by the poles not being spaced accurately magnetically, although they may be mechanically. With angular carbon brushes care must also be taken to see that they are slipped into the boxes the correct way. If the brushes of one stud are reversed sparking will ensue, since they are not equidistant around the commutator.

6. The field frame in all machines of the multi-circuit type must be concentric with the armature, *i.e.*, the axes should coincide so that the air-gap will be the same all the way round; this should be carefully tested, turning the armature round into different positions in order to eliminate errors caused by the armature not being truly wound. If the air-gap is not the same there may be sparking even on light loads. The armature must also be set so that the centre line of the armature horizontally coincides with the centre of the poles, although sometimes this will be different. Most makers supply machines of large size with multiphase equalising rings, these rings automatically equalising the potential difference between brushes without regard to the centring of the armature; but it must be borne in mind that this equalisation is only obtained at the expense of current flowing between the high and low sides, and therefore, as stated above, due care should be given to centring; this may be tested by measuring the pressure across each pair of brushes, all others being raised at the time and the speed remaining constant, and equaliser rings being of course disconnected. Obviously, in a two-pole machine, or a multipolar one with a series-wound armature, this fault cannot exist. Some makers allow a little wider air-gap at the bottom on new machines, so that when the bearing brushes get worn the armature becomes central.

7. On large new machines, more especially those having commutator split spiders or sectional clamping rings, it may be necessary to tighten up the commutator. When this has been done it should be frequently smoothed with fine carborundum sandpaper, and during the first month or so the segmental rings should be watched and kept tight until the commutator bars get a firm bearing. It is advisable to do this tightening after a good long run, when the machine is hot. Sometimes a commutator may require skimming up in the lathe, but more often it is unnecessary to do this, as good results may be obtained by stoning, *i.e.*, by using a block of sandstone about 4 to 6 in. by 8 to 10 in.; this block should be held in a wooden holder of convenient shape, and the long surface of the sandstone made to fit the arc of the commutator. A stone made in this way will usually reduce high bars, as it will not follow inequalities in the commutator. After this has been done, a sheet of fine sandpaper should be used, and a buff finish imparted by reversing the sandpaper. This method saves considerable time and money, and ensures sparkless commutation; but care must be taken to protect the armature windings and commutator leads from the grit, carbon and copper dust. If the commutator is eccentric, which is usually due to loose bearings or loose bearing pedestals, the commutator must be turned up true in the lathe. A short circuit between two bars of a commutator will easily be recognised by the blackening of the bars, and also by abnormal heating of the coils connected thereto. Sometimes it may be caused by a piece of metal getting between the bars, or by a loose piece of solder inside the commutator. More often it is due to sparking from some cause burning the mica; the spaces then get filled with carbon and copper dust, thus forming a permanent short circuit. The remedy is to clear away all dirt and scrape the space clean, and fill it up with sodium silicate and mica powder mixed to the consistency of paste. An open-circuited coil will cause excessive sparking; when running, the commutator will appear to have a continuous ring right round it. The defective coil may easily be localised, as the bars will be burned and blackened. The machine may be temporarily repaired by joining together the two bars. A grounded commutator or armature coil on a machine with one pole earthed, in the case of a motor, will usually blow the fuses; in the case of a generator, the coils short-circuited will probably be burnt out. Often considerable damage is done through the mica not wearing evenly with the copper; the mica should preferably be reduced by stoning, and then grooved out to a V shape. In large machines, never rely on testing with a magneto, since the static capacity is generally sufficiently large to ring the bell; an ordinary Wheatstone bridge or voltmeter should be used.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"F. G H." writes:—"I am under agreement as assistant with an electrical firm here. When executing work for them, I met with a severe accident to a finger, which accident, although I did not lose any time, necessitated medical attendance for some weeks. The firm admit that I am a workman within the meaning of the Employers' Liability Act, but they repudiate all liability as to doctor's fees. I might add they offer to pay all expenses of "first aid.

"Can you tell me, are they legally bound to pay? The accident was by no means due to any negligence on my part."

*** It is presumed that when "F. G. H." refers to the Employers' Liability Act, he refers to the Act which was passed in 1881. As regards the Workmen's Compensation Act, at any rate, it seems to be clear on the facts that he has no valid claim for compensation, inasmuch as he has not lost any time.

In order to make a valid claim under the Employers' Liability Act, he must prove (*inter alia*) that the accident happened owing to a defect in the condition of the ways, works, machinery or plant, or by reason of the negligence of the employer or a superintendent of machinery, or by reason of the negligence of a foreman to whose orders the plaintiff was bound to conform; and all these rules are subject to certain exceptions. Enough has been said to show that the mere fact that he is injured does not entitle a workman to make a claim for compensation. It would be necessary for him to state the exact circumstances under which the accident occurred before it would be possible to advise him upon the question whether the action is likely to succeed or not as to medical expenses. These could be recovered as part of the damages; not otherwise.

Electric Winding Engines.—It is stated that in a report issued by the Seilfahrt Committee of the Upper Mining District of Dortmund, the opinion is expressed that the safety appliances for electric winding engines made by the Siemens-Schuckert Works Co. are the best available at the present time. This company has delivered the new winding engines for Zollern II. pit and Mathias Stinnes III.-IV. pit, and the 10-metre speed has been sanctioned for the conveyance of the miners, whereas with steam winding engines only the 6-metre rate has hitherto been allowed. It is considered that the reduction of the time occupied in making the descent, which has been brought about by the adoption of electric winding engines, is of considerable importance to the coal-mining industry, not only on account of the mine legislation now in progress, but also owing to the demands of the miners for a curtailment of the length of the working shift.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

12,205. "Means for joining up two or more electric circuit wires or like conductors." Veritys, Ltd, and W. G. Pipkin. June 13th. (Complete.)

12,212. "Improvements in trolley fittings for use in connection with overhead electric traction systems." F. Woodhead. June 13th.

12,218. "A pricker or bit for perforating electric casings ready for insertion of screws." J. Dugdill. June 13th.

12,221. "Improvements in or relating to electrolytic apparatus." G. G. Hepburn. June 13th.

12,241. "A swivelling mercury contact for use on electric tramcars and the like." W. Glennon. June 13th.

12,253. "Improved electric accumulator plates for the storage of electricity." F. T. Kelley. June 13th.

12,263. "Electrolytic ship-bottom cleaner." G. W. Frazier. June 13th. (Complete.)

12,284. "Improvements in and relating to electric tremblers." J. B. Minoggia and L. E. Mere. (Date applied for under Patents Act, 1901, June 13th, 1904, being date of application in France.) June 13th. (Complete.)

12,291. "Process for the electrolytic production of lustrous metallic coatings upon metals." A. Classen. June 13th. (Complete.)

12,294. "Improved trolley pole for conducting electric current to vehicles." J. Lindsay and R. Lindsay. June 13th.

12,307. "Improvements in time-limit devices for electric switches or circuit breakers." The British Thomson-Houston Co., Ltd., E. B. Wedmore and J. Whitcher. June 13th.

12,315. "Improvements in galvanic batteries." B. J. Blameuser, E. C. Blameuser, N. Kribs and W. J. Bauble. June 13th. (Complete.)

12,319. "Improvements in switch operating mechanism." J. P. Lowe and D. F. Boissevain. June 13th. (Complete.)

12,337. "Improvements in mercurial vapour lamps and the uses thereof and shapes." F. Harrison. June 14th.

12,341. "Improvements in sanitary attachments for telephones." I. M. Slocum. (Date applied for under Patents Act, 1901, June 22nd, 1904, being date of application in the United States.) June 14th. (Complete.)

12,367. "Improvements in electrical ozonizers." C. A. Sahlstrom. (Date applied for under Patents Act, 1901, June 21st, 1904, being date of application in United States.) June 14th. (Complete.)

12,368. "Improvements in supports for electric overhead conductors." E. D. Machray. (H. J. Machray, Constantinople.) June 14th.

12,382. "Improvements in automatic selecting apparatus for use in telegraphy and telephony." P. Arnheim. June 14th.

12,386. "Improvements in alternating current generators." G. B. Marzi. (Date applied for under Patents Act, 1901, June 15th, 1904, being date of application in Italy.) June 14th. (Complete.)

12,399. "Magneto electric dumb bell." J. Moores. June 15th.

12,406. "Improvements in and connected with telephone mouthpieces." R. Knoll. June 15th. (Complete.)

12,418. "Improvements in or relating to the distribution of energy to commutator electric motors from a three-phase alternating current source." B. G. Lamme. (Date applied for under Patents Act, 1901, June 30th, 1904, being date of application in United States.) June 15th. (Complete.)

12,420. "Combined electric railway cab signal and automatic block system." J. W. Buell. June 15th. (Complete.)

12,424. "Improvements in electric telegraphy." I. Kitsee. June 15th. (Complete.)

12,431. "Improvements in or relating to electrical instruments." M. B. Field. June 15th.

12,432. "Improvements in or relating to automatic cut-offs or interrupters for electric current." D. C. Canizares. (Date applied for under Patents Act, 1901, June 30th, 1904, being date of application in Spain.) June 15th. (Complete.)

12,454. "Improvements in the electro-deposition of copper and other metals." S. O. Cowper-Coles. June 15th.

12,473. "An improved junction-box for electric cables." T. B. Reader. June 16th.

12,496. "Helix spark plug for the electric ignition of motors." E. Evrard. (Date applied for under Patents Act, 1901, March 6th, 1905, being date of application in Belgium.) June 16th. (Complete.)

12,505. "An improved electric hair brush." T. C. Hodgkinson. June 16th. (Complete.)

12,506. "Improved electrical massage apparatus." T. C. Hodgkinson. June 16th. (Complete.)

12,507. "Improvements in and relating to prepayment mechanism for electric meters." The British Thomson-Houston Co., Ltd., W. J. Lloyd and K. F. Kingwell. June 16th.

12,534. "Improvements in and relating to the mounting of electrotype, stereotype, and other printing surfaces." J. A. Corey. June 16th.

12,536. "Improvements relating to electric incandescent candle fittings." F. R. Pope. June 16th.

12,543. "Universal telephone call." M. Fouques June 16th. (Complete.)

12,546. "Improvements in apparatus for use with Nernst lamps and the like." R. W. Paul. June 17th.

12,559. "Improvements in the construction of electrical resistances." G. K. B. Elphinstone. June 17th.

12,586. "Improvements in or relating to electric telegraphy." E. Raymond-Barker. June 17th.

12,590. "Improvement in electrical igniters for explosion motors." K. Mann. (Date applied for under Patents Act, 1901, July 11th, 1904, being date of application in Germany.) June 17th. (Complete.)

12,591. "Improvements in electrical accumulators." G. Marconi. June 17th.

12,593. "Improvements in magnetically-operated switches." G. H Hill. (Date applied for under Patents Act, 1901, June 18th, 1904, being date of application in United States.) June 17th. (Complete.)

12,594. "Improvements in electric railway systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) June 17th. (Complete.)

12,595. "Improvements in, or relating to, vapour electric apparatus or devices." Sir O. J. Lodge, A. Muirhead and E. E. Robinson. June 17th.

12,598. "Improvements in and relating to incandescent electric lamps." S. Horvath and The "Utility" Co., Ltd. June 17th.

Calcium Cyanamide at Sebenico.—The plant at the carbide of calcium works at Sebenico, in Dalmatia, where some 20,000 H.P. is now developed, is about to be enlarged by the addition of apparatus for the manufacture of calcium cyanamide, the new artificial nitrogenous manure. The output of the new works is expected to reach 4,000 tons per annum.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Electrical Resistances. V. E. Vedovelli nee Del Castillo. (Date claimed for patent under Patents Act, 1901, October 19th, 1903, being date of application in France.) 9,375. April 23rd.

Electric Shoes. J. W. Gibbs. (Date claimed for patent under Patents Act, 1901, July 16th, 1903, being date of application in U.S.) 9,453. April 25th.

Heating the Charge of Electric Furnaces. A. Neuburger and A. Minet. 2,468. April 25th.

Galvanic Battery Cells. W. O. Duntley. 9,523. April 26th.

Sanitary Rotating Diaphragm for Telephones. S. Churchill-Otton. 9,683. April 27th.

Electric Circuits for the Production of Constant Current, or Constant Potential, or of both. R. W. James. (The Northern Electric Co., U.S.) 9,831. April 29th.

Electric Switches. G. S. Dunn. (Date claimed for patent under Patents Act, 1901, August 25th, 1903, being date of application in U.S.) 9,874. April 29th.

Magneto-Electric Igniting Device. C. Hauptmann. 9,914. April 30th.

Electrical Percussive Drill. P. Centner. 9,964. April 30th.

Electric Cables. A. Berlin. 10,036. May 2nd.

Electric Switches. The General Contracts Co., Ltd., E. S. Cook and W. H. Chipperfield. 10,058. May 2nd.

Adapting Electric Candles to Sconces and the like. C. C. Regnart. 10,119. May 3rd.

Electrical Conductors. P. A. McGeorge. 10,142. May 3rd.

Electric Converters. R. A. Müller. 10,171. May 3rd.

Dynamo-Electric Machines. O. Imray. (Bullock Electric Manufacturing Co., United States.) 10,172. May 3rd.

Electric Switch and Plug Connector. W. H. Warren and C. E. Hunter. 10,173. May 3rd.

Electric Block Signal Systems. T. Silvene. 10,276. May 4th.

Secondary or Storage Battery Plates. A. J. Boult. (C. Potter, United States.) 10,370. May 5th.

Electric Bath. H. I. W. Schwedler. 10,393. May 5th.

Electric Cables. A. Whalley and E. A. Bayles. 10,490. May 6th.

Controlling or Regulating Means for Electrical Apparatus. A. J. Boult. (J. B. Entz, United States.) 10,646. May 9th.

Bearings for the Motors of Electrically-propelled Vehicles. C. de Kando. 10,647. May 9th.

Electric Motor Systems. C. de Kando. 10,648. May 9th.

Receiving Apparatus for Wireless Telegraphy. L. Cerebotani and A. Silbermann. 10,858. May 11th.

Electrically Stopping Railway Trains. E. Lichtenfels. 10,906. May 11th.

Electrically-operated Hoisting Winch. A. J. Gustin. 11,111. May 13th.

Telephonic Selecting Systems. W. D. Watkins. 11,274. May 16th.

Incandescent Electric Lamps. D. J. O'Brien. 11,439. May 18th. (Date claimed for patent under Patents Act, 1901, May 25th, 1903, being date of application in United States.)

Electric Current Switches. J. Hall and A. Hackblock. 11,568. May 19th.

A Portable Insulated Support for Double Wire Electric Lines. A. Collett. 11,651. May 20th. (Date claimed for patent under Patents Act, 1901, August 4th, 1903, being date of application in France.)

Electric Igniters for Explosion Motors. W. Sander. 11,848. May 24th.

Electric Switches. F. Stevens. 11,857. May 24th.

Electric arc Lamps. H. J. Daddan. (Firm trading as Allgemeine Beleuchtungs und Heizindustrie Actien-gesellschaft, Germany.) 11,862. May 24th.

Prepayment Electrical Measurement Instruments. C. Conrad. (Date claimed for patent under Patents Act, 1901, June 24th, 1903, being date of application in U.S.) 12,087. May 27th.

Automatically maintaining Accumulator Charging Currents Constant. Aktien-gesellschaft Brown, Boveri & Cie. (Date claimed for patent under Patents Act, 1901, June 26th, 1903, being date of application in Germany.) 12,097. May 27th.

Automatically putting Alternating Current Transformers into or out of Circuit. J. A. E. Mariage. 12,268. May 30th.

Electric Arc Lamps. J. A. Heany. 12,344. May 31st.

Electric Arc Lamps. J. A. Heany. 12,345. May 31st.

Electric Fire Alarm and the like Signalling Apparatus. F. Hubber and W. G. Higgs. 12,439. June 1st.

Small Motor for Alternating Current. F. Reiss and R. Klemm. 12,449. June 1st.

Material and Composition to be used for Damp Courses in Building, for Covering Roofs, the Surfaces of Bridges, Viaducts, Arches, Sewers, and the like for Preventing the Access of Damp to Iron Girders and the like for the Insulation of Electrical Conductors, and for other purposes of like kind. W. L. Watson. 12,518. June 2nd.

Production of Chemical Reactions in Gases and Vapours by Electric Discharges. Count A. de Montlaur. 12,541. (Date claimed for patent under Patents Act, 1901, June 3rd, 1903, being date of application in France.) June 2nd.

Simultaneous Transmission of Telephonic and Telegraphic Currents over the same Line. C. Turchi. 12,691. June 4th.

Process for the Production of Electrical Resistance Bodies from Amorphous or Crystalline Carbide of Silicon or Boron, or of Silicon or other like suitable materials. W. P. Thompson. (Chemisch Elektrische Fabrik "Prometheus" G.m.b.H., Germany.) 12,707. June 4th.

Electric Railways, and Motor Vehicles therefor. R. C. Sayer. 12,729. June 6th.

Coin-freed Apparatus for supplying a Current of Electricity to Persons using it, after the insertion of a predetermined Coin, and for indicating the Strength of the Current supplied. J. Carter and S. H. Leheup. 12,755. June 6th.

Telephones. J. J. Nye and M. Peck. 12,977. June 8th.

Telephone Exchange Systems. W. Aitken. 13,216. June 11th.

Brake and Means for Suspension for Overhead Electrically-driven Locomotives. W. Fairweather. (The Brown Hoisting Machinery Co., United States.) 13,427. June 14th.

Electrical Locomotive. W. Fairweather. (The Brown Hoisting Machinery Co., United States.) 13,428. June 14th.

Overhead Travellers used for Hoisting and Conveying Purposes. W. Fairweather. (The Brown Hoisting Machinery Co., United States.) 13,430. June 14th.

Cleaning out Accumulator Batteries. H. Hicking. 13,433. June 14th.

An Electric Block Signal System. L. C. Werner. 13,463. June 14th.

Electric Switches. W. M. Scott. (Date claimed for patent under Patents Act, 1901, July 31st, 1903, being date of application in U.S.) 13,468. June 14th.

Envelopes for Vapour Electric Conductors. E. Weintraub. Date claimed for patent under Patents Act, 1901, June 15th, 1903, being date of application in U.S.) 13,567. June 15th.

Supplement to the "ELECTRICAL REVIEW," June 23rd, 1905.

"ELECTRICAL REVIEW" LIST OF ELECTRI

Place.	Supply Authority.	Year of opening	Engineer.	Pressure of supply, volts.	Frequency and Phase.	Boilers and Auxiliaries.	Engines.	Generators.	Total Capacity in KW.	Max. loa recorde in KW
PROVINCIAL.										
1 ABERDEEN	Corporation	1894	J. Alex. Bell	220 & 440 Tr. 500	Direct	6 B. & W., 2 suphtrs. (Cotton St.). / 6 B. & W., suphtrs., ch. g. stokers, cond. (Dee Village).	3 Willans, 1 Belliss / 8 Willans (1 on order)	2 E. C. C., 1 Crompton, 1 Mather & Platt / 1 J. Lundell, 3 Mavor & Coulson, 2 Westinghouse, 1 Peebles, 2 Holmes	666 / 2,100	2,766
2 ABERYSTWYTH	A. & Chiswick Elec. Supply Corpn.	1895	W. L. Knight	100 & 220	100~ 1-ph., & direct	3 Paxman Economic	4 Browett-Lindley, 2 Peache	2 Johnson & Phillips, A. C., 2 J. & P. D. C., 2 Brush arc.	240	140
3 ACCRINGTON	Corporation	1900	H. Gray	230 & 460	Direct	3 Lanc., econ., cond.; 6-cell Horsfall destructor.	3 Willans, 2 Browett-Lindley	3 J. & P., 2 Lanc. D. & M. Co.	535	256
4 ACTON	Urban District Council	1905	J. Martin Blair	230 & 460	Direct	Supply in Bulk from	Met. Elec. Supply Co.	2 E.C.C., 2 Lanc. D. & M. Co. (motor-generators)	780	..
5 ALDERLEY EDGE AND WILMSLOW	Alderley & Wilmslow Elec. Supply.	1899	Cuthbert W. Bentley	210	Direct	2 loco. (Paxman)	2 Belliss	2 Edison & Swan	92	65
6 ALDERSHOT TOWN	Urban District Council	1902	F. Garside	210 & 420	Direct	3 B. & W., econ., cond.	4 Willans	4 Parker	440	146
7 ALLOA	Corporation	1902	J. W. Napin	220 & 440	Direct	Supply in bulk	from the British	Electric Plant Co., Ltd.	..	58
8 ALNWICK	Northern Counties Elec. Supply Co.	1902	C. S. Vesey Brown / C. W. Fairweather	230 & 460	Direct	2 B. & W., stokers and econ.	2 Ruston Proctor	2 Crompton	150	..
9 ALTRINCHAM & DIST.	Altrincham Electric Supply	1895	H. C. Caldwell	100	80~, 1-ph.	6 Lanc.	5 Browett-Lindley	5 Edison & Swan	660	446
10 ASHTON-U-LYNE	Corporation	1899	N. Appelbee	240 & 480	Direct	4 Lanc., 2 tubular, econ., 4-cell Horsfall destr.	2 Browett-Lindley, 2 Belliss	3 Jackson (Sayers), 3 Siemens	1,260	1,014
11 ASTON MANOR	Corporation	1903	R. Foster	240 & 460	Direct	6 B. & W., suphtrs., Vicars stokers, econ., 4-cell Hughes-Stirling destructor, Boby detart.	3 Ferranti, 1 Yates & Thom, 1 Belliss, 1 Reavell	2 Dick Kerr, 3 G. E. Co., 1 Westinghouse	2,265	820
12 ATHERTON	Urban District Council	1903	D. Williams	230 A.C., 500 D.C.	50~ 2-ph., & direct	Supply in bulk from	South Lancashire Electric	Traction & Power Co., Ltd.	..	..
13 AYR BURGH	Corporation	1896	Roland Marshall	100 & 200 A.C., 250 & 500 D.C.	60~, 1-ph. & direct	4 Lanc., 2 Stirling, 2 B. & W., Vicars and ch. g. stokers, 6-cell Meldrum destr.	7 Belliss, 1 Marshall	4 Siemens A. C.; 2 Bruce Peebles, 2 Siemens, D. C.	1,325	600
14 BANBURY	Banbury & District Elec. Supply Co.	1903	Arthur J. Wray	230 & 460	Direct	2 B. & W.	3 Parsons turbines	3 Parsons	369	87.6
15 BANGOR (WALES)	Corporation	1900	P. F. White	200 & 400	Direct	2 Hornsby water-tube, 2-cell Meldrum destr.	3 Willans	2 Fowler, 1 J. P. Hall	290	187
16 BARKING	Urban District Council	1899	A. H. Seabrook	230 & 460	Direct	4 B. & W., cond., clg. tr.	2 Sunderland Forge, 3 Allen	2 S. Forge, 2 Thames Ironworks, 1 Siemens	610	475
17 BARNES & MORTLAKE	Barnes Urban District Council	1901	C. S. Davidson	210 & 420	Direct	3 B. & W., cond., fd. htr.	4 Belliss	4 Siemens	470	210
18 BARNSLEY	Corporation	1900	E. A. Barker	230 & 460	Direct	6 Lanc., stokers, cond., econ.	7 Willans	4 J. & P., 3 Peebles	1,200	730
19 BARNSTAPLE	Corporation	1903	J. W. Hadfield	230	Direct	3 B. & W., suphtrs., econ., cond.	3 Reavell	3 Taunton	375	180
20 BARROW-IN-FURNESS	Corporation	1899	H. R. Barnett	220 & 440	Direct	5 B. & W., econ., cond., Heenan & Froude 4-cell dest.	3 Universal, 4 Willans	3 Brush, 2 Peebles, 2 Dick Kerr	1,025	740
21 BATH	Corporation	1890	Francis Tracie	100 A.C., 220 D.C.	100~ 1-ph., & direct	4 B. & W. land type, 1 B. & W. marine	4 Belliss, 2 Pollitt & Wigzell, 4 Brush	2 E. C. C., 4 Mordey (rope-driven) & 4 Dick Kerr	2,200	916
22 BATLEY	Corporation	1903	S. D. Jones	220 & 440	Direct	3 Lanc., Proctor stokers, econ., cond., clg. tr., and 1 Lanc. with 3-cell Horsfall destr.	4 Belliss	3 Fowler, 1 Westinghouse	850	450
23 BECKENHAM	Urban District Council	1900	J. E. Tapper	200 & 400	50~, 1-ph.	4 B. & W., suphtrs., econ., detart., 3-cell Horsfall dest.	3 Belliss, 1 Browett-Lindley	3 Fowler, 1 Johnson & Phillips	550	310
24 BEDFORD	Corporation	1894	R. W. L. Phillips	105 & 210	60~ 1 ph.	7 B. & W., 2 Lanc., stokers, cond.	2 Belliss, 5 Allen	1 Johnson & Phillips, 2 Siemens, 3 Fynn	860	560
25 BELFAST	Corporation	1895	V. A. H. McCowen	220 & 440	Direct	6 Lanc., Victor Coates, 6 B. & W., stokers, econ., feed htrs., cond., clg. tr.	11 Belliss	6 Parker, 6 M. & P., 1 J. & P.	3,400	2,243
26 BERWICK-UPON-TWEED	Urban Electric Supply Co.	1903	J. Hayward Home	240 & 480	Direct	2 Sugden water tube	2 Belliss	2 Crompton	180	78
27 BEXHILL-ON-SEA	Corporation	1900	W. T. Le Feuvre	220 & 440	Direct	2 Hornsby, 2 B. & W., suphtrs. (1 sep. fired), cond., clg. tr.	3 Allen, 1 Belliss	3 Allen, 1 Brit. Westinghouse	650	383
28 BEXLEY	Urban District Council	1903	C. Mitt-Ihousen	240 A.C., 500 D.C., tr.	50~ 1-ph.	3 Lanc.	2 Browett-Lindley	Dick Kerr, 2 A.C., 2 D.C. (traction)	A.C. 300 D.C. 300	..
29 BIRKENHEAD	Corporation	1896	W. Bates	230 & 460	Direct	4 Lanc., Vicars stokers, 2 B. & W., ch. gr. stokers	8 Willans, 1 Scott & Mountain	4 Crompton, 2 Siemens, 2 Mavor & Coulson, 1 Scott & Mountain	1,375	652
30 BIRKDALE	Birkdale District Elec. Supply Co.	1902	H. Bentham	230 & 460	Direct	3 B. & W.	3 Browett-Lindley	3 Bruce Peebles	300	186
31 BIRMINCHAM	Corporation	1891	R. A. Chattock	220 & 440	Direct	20 Lanc., 6 B. & W.	13 Willans, 9 Belliss, 2 Parsons (turbines)	4 Mather & Platt, 13 Crompton, 5 E. C. C., 2 Parsons	5,760	4,350
32 BLACKBURN	Corporation	1895	P. P. Wheelwright	110, 220 A.C., 220 & 440 D.C.	50~, 1-ph., & direct	12 Lanc., stokers, econ., cond.	8 Willans, 7 Belliss	1 Mather & Platt, 7 Siemens, 3 Mavor & Coulson, 3 Dick Kerr	4,518	2,100
33 BLACKPOOL	Corporation	1893	Charles Furness	200 A.C., 500 D.C.	83~ 1-ph., & direct	5 Lanc., 2 Fraser, 5 B. & W.	2 Fowler, 1 Ferranti, 7 Parsons turbine, 1 Browett Lindley	7 Parsons, 2 Fowler, 2 E. C. C., 1 Ferranti and 1 Westinghouse	3,250	1,900
34 BLAENAU FESTINIOG	Vale Electric Power Co.	1900	T. P. O. Yale	220, 230 & 500	Direct		Water turbines, by Gilkes, Cassell and Escher Wyss	6 Sandycroft Foundry	720	..
35 BLYTH & COWPEN	Northern Counties Elec. Supply Co.	1901	C. S. Vesey Brown / C. W. Fairweather	230 & 460	Direct	2 B. & W., econ.	2 Allen	2 Crompton	400	..
36 BOLTON	Corporation	1894	A. A. Day	100 A. 200 A.C. 230 & 460 D.C.	83~, 1-ph., & direct	13 Lanc., stokers, suphtrs., cond., clg. tr., econ.	6 Musgrave, 4 Hick Hargreaves	2 Dick Kerr, 4 Mather & Platt D.C., 4 Ferranti A.C.*	5,000	2,685
37 BOOTLE	Corporation	1899	T. D. Clothier	220	Direct	8 Lanc., stokers, econ., cond.	6 Belliss, 2 Ferranti	5 Parker, 1 E. C. C., 2 Bruce Peebles	2,050	1,029
38 BO'NESS	National Electric Construction Co. (for the Corporation)	1905	J. M. McGown	230 & 460	Direct	2 Heenan & Froude water tube	2 Davey Paxman	2 Lanc. D. & M. Co.	200	54
39 BOURNEMOUTH AND POOLE	Bournemouth & Poole El. Supply Co.	1889	E. Ll. Ingram	100 & 200 A.C., 480 D.C.	100~ 1-ph., & direct	9 B. & W., cond., clg. tr.	7 Brush, 2 Browett-Lindley	2 Ferranti, 5 Brush A.C., 2 Brush D.C.	3,610	1,485
40 BRADFORD	Corporation	1899	A. S. Blackman	230 & 460 Tr. 500	Direct	4 Lanc., 6 marine, ind. draught, stokers, 10 water-tube, suphtrs., econ., cond., clg. tr.	19 Willans, 1 Marshall, 2 Coie, Marchant & Morley, 2 Musgrave	15 Siemens, 2 E. C. C., 2 Peebles, 4 Westinghouse, 1 Phoenix	8,680	6,382
41 BRAY	Urban District Council	1892	W. J. U. Sowter	100 & 200	60~, 1-ph.	1 loco., 2 Lanc., cond., econ.	1 Brush, 1 Easton - Anderson, 1 Browett-Lindley, 1 Victor turbine	1 Witting, 1 International, 1 Easton-Anderson, 1 J. & P.	320	108
42 BRECHIN	North of Scotland E. L. & P. Co.	1901	H. Dixon, res.	240 & 480	Direct	2 B. & W., suphtr., feed htr.	3 Belliss	3 Parker	282	79
43 BRIDGWATER	Bridgwater & District Electric Supply & Traction Co.	1904	Harold Mather	230 & 460	Direct	Dowson gas producer	2 British Westinghouse	3 British Westinghouse	200	80
44 BRIDLINGTON	Corporation	1905	Arthur J. Beckett	230 & 440	Direct	2 Lanc.	2 Allen	2 Johnson & Phillips	220	102
45 BRIGHOUSE	Corporation	1898	A. Aspinall	110	Direct		3 Crossley gas	3 Brook	40	40
46 BRIGHTON	Corporation	1891	J. Christie	115, 230, & 460	Direct	6 Lanc., 10 B. & W.	18 Willans	2 Goodden, 2 Siemens, 3 Crompton, 3 Peebles, 8 E. C. C.	6,135	4,584
47 BRISTOL	Corporation	1893	H. Faraday Proctor	250 & 500 D.C., 105 & 210 A.C.	93~, 1-ph. & direct	14 B. & W., 9 Lanc., stokers, suphtrs., cond.	19 Willans, 3 Parsons turbine	13 Siemens, 4 Dick Kerr, 2 Parsons, 1 Peebles	7,092	4,279
48 BROMLEY (KENT)	Bromley (Kent) Elec. Lt. & Pr. Co.	1898	R. R. Barker	210	Direct	4 Paxman Economic, cond.	6 Belliss	6 Parker	800	380
49 BROUGHTY FERRY	Corporation	1902	J. L. Turnbull	230 & 460	Direct	2 B. & W., suphtrs., cond.	2 Belliss	2 Parker	90	50
50 BUCKINGHAM	Buckingham Electric Light Co.	1889	T. Gillies (man.)	220	Direct	1 Marshall loco., and Dowson suction gas producer	1 Marshall (steam), 1 National & 1 Grice gas engines	1 Greenwood & Batley, 2 Elwell-Parker, 1 Johnson & Phillips	70	..
51 BURNLEY	Corporation	1893	R. Birkett	220 & 440	Direct	5 Lanc., stokers, econ.	3 Burnley Iron Works, 4 Belliss	3 Parker, 2 E.C.C., 2 Dick Kerr	1,500	1,247
52 BURTON-ON-TRENT	Corporation	1894	P. J. Pringle	100 & 200 A.C., 500 D.C. (Tr.)	75~, 1-ph. & direct	6 Lanc., econ., cond., 5 fed. drt., 1 Bennis stoker	3 Fowler, 1 Alley & Macfellan, 4 Willans	3 Fowler, 1 Brown-Boveri, 1 Bruce Peebles, A.C.; 3 E. T. H., D.C.	1,610	Lg. 427, tr. 250
53 BURY (LANC.)	Corporation	1896	S. J. Watson	220, 440 & 500	Direct	5 Lanc., econ., cond.	6 Belliss	6 Siemens	1,240	1,158
54 BURY ST. EDMUNDS	Corporation	1900	L. P. Greig	200 & 400	Direct	2 Lanc., detart., econ.	3 Belliss	3 Fowler	232	165.5
55 BUXTON	Urban District Council	1900	W. J. Leeming	210	Direct	6 Hornsby w.t., cond.	6 Belliss	6 M. & P., 2 Sunderland Forge, 1 E. C. C.	538	234
56 CAMBORNE, REDRUTH AND ILLOGAN	Urban Electric Supply Co.	1902	F. S. Hanning	240 & 480 Tr. 500	Direct	2 Lanc., 1 B. & W., suphtr.	4 Belliss	5 Parker	480	286
57 CAMBRIDGE	Cambridge Electric Supply Co.	1892	H. B. Harvey	210	90~, 1-ph.	4 Lanc., econ.	7 Parsons turbines	7 Parsons	1,500	616
58 CAMBUSLANG	Lanark County Council	1905	A. J. Abraham	250	Direct	2 Lanc., 3-cell Meldrum dest.	Howden	Parker	110	..
59 CANTERBURY	Corporation	1899	C. A. Blaschcek	220	Direct	4 Lanc., Proctor stokers, 1 Paxman Economic; 1 B. & W. with 2-cell Beaman & Deas destr.	5 Belliss	6 Silvertown, 2 Johnson & Phillips, 2 Dick Kerr	900	350
60 CARDIFF	Corporation	1894	Arthur Ellis	200, 400 & 500	40~, 1-ph., & direct	5 dryback, 3 B. & W., suphtrs., cond.	2 Paxman, 3 Belliss, 1 Ferranti	5 Siemens, 1 Ferranti	1,560	918 A.C. 795 D.C.
61 CARLISLE	Corporation	1899	C. D. Burnet	230, 400, 500 tr.	Direct	5 Lanc., stokers, econ., cond.	6 Willans	2 Peebles, 4 Siemens	870	521
62 CARLOW	J. Alexander	1890	O. St. J. McKee	100 & 200	70~, 1-ph., & direct	1 B. & W.	1 Belliss; 2 Waverley, 1 Vortex, turbines (water)	2 E. C. C., A. C.; 3 Laurence Scott, D.C.	115	..
63 CARNARVON	National Electric Construction Co. (for the Corporation)	1905	A. C. Goodman	230 & 460	Direct	2 Economic	2 Peache	2 Lanc. D. & M. Co.	200	..
64 CATERHAM	Urban Electric Supply Co.	1903	F. Bruton	220	Direct	2 Sugden	2 Belliss	2 G.E.C.	88	41
65 CHAGFORD	Chagford & Devon Elec. Light Co.	1891	Geo. H. Reed	100	90~, 1-ph.		Water Wheel	2 Siemens	22	19
66 CHELMSFORD	Chelmsford Electric Lighting Co.	1890	A. H. French	100 & 200	100~, 1-ph.	2 Lanc., 3 B. & W., ch. g. stokers	5 Willans, 1 Peache	8 Crompton	865	374
67 CHELTENHAM	Corporation	1895	M. H. Kilgour	100 & 200	100~, 1-ph., & direct	1 Lanc., 6 B. & W., econ.	3 Willans, 4 Belliss, 2 Parsons turbines	5 Siemens (2 D.C., 3 A.C.), 2 Parsons A.C., 2 Witting D.C.	1,700	750
68 CHEPSTOW	Chepstow Elec. Light & Power Co.	1904	A. C. Wilkins	230	Direct	2 Paxman loco.	2 Peache	2 Silvertown	100	..
69 CHESHAM	Empire Electric Light & Power Co.	1904	R. J. J. Swan	230 & 460	Direct	2 Paxman Economic	2 Peache	2 British Westinghouse	250	116
70 CHESTER	Corporation	1896	S. E. Britton	210	Direct	7 B. & W., stokers	7 Belliss	6 Parker, 1 Mather & Platt	1,300	905
71 CHESTERFIELD	Corporation	1901	R. L. Acland	240 & 480	Direct	6 B. & W., econ.	5 Belliss	5 Westinghouse	1,000	610
72 CHISLEHURST	Chislehurst Electric Supply Co.	1899	A. E. Darlington	210	Direct			2 Parker motor transformers	80	50
73 CHISWICK	Chiswick Electricity Supply Corp.	1900	A. W. Money	220 & 440	Direct	4 Economic, forced draught	5 Peache	5 Johnson & Phillips	921	396
74 CHRISTCHURCH AND SOUTHBOURNE	Bournemouth & Poole El. Supply Co.	1903	E. Ll. Ingram	250 & 500	Direct	2 B. & W.	2 Belliss	2 Siemens	200	..
75 CLECKHEATON	Urban District Council	1902	A. Pickersgill	230 & 460	Direct	4 Lanc. (2 fired by 4-cell Meldrum destructor)	3 Belliss, 1 Gourlay	3 Johnson Lundell, 1 Phœnix	800	410
76 COATBRIDGE AND AIRDRIE	Scottish House-to-House Elec. Co.	1894	J. A. Donachie	240 & 480	Direct	3 Lanc., cond.	2 Browett-Lindley, 2 Belliss	2 Brush, 2 Mavor & Coulson	800	450
77 COLCHESTER	Corporation	1898	A. R. Sillar	210 & 420 500 tr.	Direct	5 Paxman Economic, cond.	7 Peache	5 Siemens, 2 Mather & Platt	1,280	692
78 COLNE	Corporation	1901	A. G. Cooper	240 & 480	Direct	2 Lanc. stokers, suphtrs., econ., cond. 1 B. & W. with 2-cell Beaman & Deas dest.	1 Parsons turbine, 3 Belliss	1 Parsons, 2 Greenwood & Batley, 1 Bruce Peebles	770	..
79 COLWYN BAY	Urban District Council	1901	A. R. Tudman	220 & 440	Direct	2 B. & W.	3 Browett-Lindley, 1 Stockport (gas)	4 Bertram Thomas	315	200
80 CORK	Cork El. Tramways & Lighting Co.	1898	H. H. Nalder	230 & 460	Direct	7 B. & W.	2 Allis, 3 McIntosh & Seymour, 1 Belliss, 1 Curtis	7 B. T. H.	1,850	1,007
81 COVENTRY	Corporation	1895	J. A. Jeckell	200	87~, 1-ph. & 50~, 2-ph.	4 Lanc., stokers, econ., cond.	3 Fowler, 1 Belliss, 2 McLaren	2 Fowler, 1 Fynn, 1-ph 2 British Schuckert, 2-ph.	1,800	526
82 CREWE	Corporation	1900	H. H. Denton	230 & 460	Direct	3 Lanc., stokers, econ., cond.	3 Willans	3 Mather & Platt	540	270
83 CROMER	Cromer Electricity Supply Co.	1903	Edgar Hesketh	210	Direct	2 Sugden water tube, suphtrs.	2 Belliss	2 Parker	190	..
84 CROYDON	Corporation	1896	Alex. C. Cramb	200 A.C. & 230 D.C.	60~, 1-ph. & direct	5 Paxman, 6 B. & W., 2 Danks multitub., 3 clg. trs., suphtrs., econ.	11 Belliss	9 B.T.H., 1 E.C.C., 1 Dick Kerr	4,165	2,161
85 DARLINGTON	Corporation	1900	J. R. P. Lunn	230 & 460	Direct	4 Lanc.	4 Scott & Mountain, 2 Allen	6 Scott & Mountain, 2 Parker	692	610
86 DARTFORD	Urban District Council	1901	J. D. Pember	230 & 460	Direct	3 Lanc., stokers, cond.	3 Reavell	2 G. E. Co., 1 Lanc. D. & M. Co.	500	..
87 DARTMOUTH	Urban Electric Supply Co.	1902	G. E. Smith	240	Direct	2 B. & W., suphtrs., Boby heater	2 Belliss	2 Parker	180	89
88 DARWEN	Corporation	1899	C. Garnett	230 & 460	Direct	4 Lanc., stokers, cond., Meldrum 2-cell destructor	4 Belliss	2 Siemens, 1 Mather & Platt, 1 Peebles	900	780
89 DERBY	Corporation	1893	T. P. Wilmshurst	100 & 200 A. 230 & 460 D.	40~, 1-ph. & direct	6 Lanc., 5 B. & W., econ.	3 Ferranti, 5 Browett-Lindley, 3 Parsons turbines	3 Ferranti, 5 Siemens, 3 Parsons	3,200	1,600
90 DEVONPORT	Corporation	1901	J. W. Spark	230, 460 & 500	Direct	5 B. & W., cond., feed htrs., econ.	1 Browett-Lindley, 3 Ferranti, 1 Willans	5 E. C. C.	1,860	Lg. 300, tr. 550
91 DEWSBURY	Corporation	1894	R. H. Campion	220 & 440	Direct	4 Lanc., econ.	7 Willans, 1 Belliss	3 Crompton, 2 Peebles, 1 Dick Kerr, 3 Siemens	1,000	Lg. 333, tr. 300
92 DISS	Suffolk Electricity Supply Co.	1898	Napier Prentice	200	Direct		2 Stockport (gas)	1 Prentice, 1 Anglian	48	22
93 DONCASTER	Corporation	1900	E. S. Rayner	230	Direct	4 Lanc., stokers	7 Willans	7 Mather & Platt, and Bruce Peebles	909	606
94 DORKING	Urban District Council (leased to Edmundson's Electricity Corp.)	1904	C. Lakin-Smith	240	Direct	B. & W.	2 Belliss	2 Parker	180	82.9
95 DOVER	Corporation	1895	L. W. Woodman	100 & 200 A.C. 500 D.C.	100~, 1-ph. & direct	6 B. & W., econ., cond.	4 Brush, 2 Macintosh & Seymour, 1 Ball & Wood, 1 Ferranti, 1 Parsons	1 Ferranti, 4 Brush, 1 Parsons A.C.; 3 G.E.C. (Am.), D.C.	1,650	610
96 DUBLIN	Corporation	1892	M. Ruddle	200	50~, 1-ph. & 3-ph.	4 B. & W., 6 Lanc.	4 Stewart, 1 Belliss	4 Oerlikon, 1 G.E. Co.	4,500	2,000
97 DUDLEY	Corporation	1899	C. Ashmore	230 & 460	Direct	6 B. & W., stokers, fd. htrs., econ., cond., Thermal Baker	4 Westinghouse, 2 Ferranti	4 Westinghouse, 2 E.C.C.	1,600	Lg. 388, tr. 860.
98 DUNDEE	Corporation	1893	R. Richardson	500	Direct	8 Lanc., econd., feed htrs., econ., 2 B. & W., stokers	11 Willans	1 Dick Kerr, 6 Siemens, 3 Parker, 1 Int. E. E. Co.	3,010	2,130
99 DURHAM	County of Durham E.P.D. Co.	1902	A. S. Esselmont (man.)	240 & 4	60* Direct	2 B. & W., 1 Woodeson (Clarke, Chapman) suphtrs.	3 Brush	3 Brush	400	172
100 EALING	Corporation	1904	J. Douglas Knight	102 & 2	104 40~, 1-ph.	6 Lanc., 4 stokers, cond., 1 Stirling	7 Browett-Lindley, 3 Belliss, 1 Davey-Paxman	Siemens, 8 A.C., 3 arc (1,800 V. D. C.)	1,000	1,008
101 EASTBOURNE	Corporation	1903	J. K. Brydges	200	50~, 1-ph.	2 Stirling, 2 Hornsby, 1 Economic, 1 B. & W.	2 Ferranti, 2 Willans, 1 Peache	2 Ferranti, 3 E.C.C.	1,300	875

PART I.

CTRICITY SUPPLY WORKS OF THE UNITED

	Total Capacity in KW.	Max. load recorded in KW.	Storage Battery.	Mains.	Total capital expended.	Private lighting, eqvt. 8 c.p. lamps.	Public lighting.	No. and H.P. of private motors.	No. and H.P. of traction motors.	Total connections of all kinds, eqvt. 8 c.p. lamps.	Percentage increase during year.	Price charged per unit, pence.	System of charging.	Units sold during last complete year.	PENCE Av. price obtained.
&	666	2,766	E.P.S., 20 KW. for 10 hrs. E.P.S., 90 KW. for 10 hrs.	Bare copper, bit. paper and jute in Crompton Davies casing, iron pipes, wdn. troughing, solid	£220,743	103,434	289 arc	408=1720 H.P.	138=3,450 H.P.	154,100 ex. tr.	21.8	Lg. 6 & 2½, pb. lg. 6 & 2, pr. 3 & 1, tr. (corp.) 1.37, (co.) 2¼	Max. demand, except for tr.	3,530,626	2.49
, 2 ues	2,100														
&	240	140	.. ..	B.I. & H., armd. and lead covd., conc.	..	9,795	29 arc, 1 inc.	..	..	10,250	..	Lg. 6	Flat rate	..	..
..	535	256	Chloride, max. dis. 160 KW..	Glover and B.I. & H., single core ppr.; feeders solid, dist. armd. direct	£45,707	18,631	16 arc, 62 inc. 87 Nernst	43=195 H.P.	..	27,439	17.1	Lg. 4, pb. lg. 3, pr. 3 & 1	Flat rate	312,205	3.03
Co.	780	..	E. P. S., 150 KW.	Dialite cables, laid solid in Howard troughing; St. Helen's Cable Co.	£50,000	..	..	..	..	16,000	..	Lg. 5, pr. 2	Flat rate	..	..
..	92	65	D.P., 240 KW. hrs.	Callender, triple conc. fdrs., 3-core dist.; both lead covd. and armd.; laid direct	£25,600	9,026	..	1=2 H.P. ..	..	9,026	20	Lg. 7 & 4, pr. 2½ ..	Max. demand & flat rate	60,624	4.7
..	440	146	D.P., max. dis. 150 amp. Pritchetts & Gold on order	Callender feeders and distributors, single, laid solid ..	£24,500	..	17 arc, 18 inc., 3 Nernst	9=23 H.P. ..	..	9,250	..	Lg. 6 & 4 or 5, pr. lg. 2½, pr. 3 & 2	Max. demand and flat	..	..
.	..	58	.. ..	Callender, fdrs. 3-core, dist. single, v. bit., solid ..	£9,500	2,800	20 arc ..	7=9 H.P. ..	..	8,125	..	Lg. 7 & 3, pr. 2 ..	Max. demand	58,500	..
..	150	..	Chloride, 250 amp.-hrs. ..	Callender, single, solid, in wood troughs	£12,000	..	..	..	..	..	..	Lg. 5½ to 4, pr. 2½ to 1½ ..	Sliding scale	..	..
..	660	446	.. ..	Feeders, Glover, v. r. in pipes; dist. B. I. & H.; lead covd. and armd.	£61,884	38,676	..	7=30 B.H.P.	..	47,670	6.72	Lg. 6, pr. 3	Flat rate and contract	486,997	5.25
..	1,200	1,014	.. ..	Conc. paper and bitumen	£64,662	19,746	98 arc, 130 inc. 1 Nernst.	36=144 H.P.	120=3,000 H.P.	100,582	..	Lg. 4, pb. lg. 1.6, pr. 1.5 to 0.9, tr. 1.5 to 1.0	Flat rate and sliding scale	1,805,590	1.69
g-	2,265	820	.. ..	B.I. & H., triple conc. and 3-core, part in e'ware ducts, part solid	£95,000	21,913	15 arc, 30 inc.	52=409 H.P.	36=1,800 H.P.	80,921	..	Lg. 3½ to 2½, or 6 & 1½, pr. 2 to 1, tr. 1*	Max. demand, sl. scale & 2 p.c. inc.	..	..
d.	..	..	.. ..	Callender, conc., ppr. ins. bit. solid in wood troughs ..	£10,000	2,300	..	12=194 H.P.	..	6,850	..	Lg. 5, pr. 3 to 2 ..	Flat rate	..	4.84
s,	1,925	600	E. P. S., 30 KW. for 7 hrs. max. disch. 100 KW.	Callender, conc. armd., A.C. bit. solid, D.C. in wood ..	£87,525	36,500	121 arc, 155 inc., 10 N.	31=83 H.P.	32=800 H.P.	41,000	70	Lg. 5, pr. & p. .. 2 pr. lg. 1.3	Flat rate ..	1,047,781	2.45
.	369	87.6	Hart, max. dis. 14 KW. ..	Callender, fdrs. twin conc. v. bit., dist. 3-core, all laid solid	..	..	2 arc, 4 inc., 3 Nernst	7=55½ H.P.		7,500	..	Lg. 7 & 2½, pr. .. 1·8, pr. 1.5	Max. demand	60,240	4.4
.	290	187	Hart, 35 KW. for 6 hrs. ..	B.I. & H. triple conc. ppr. lead covd. and armd. ..	£24,222	9,013	..	8=19½ H.P.		9,487	8.2	Lg. 5, pr. 2½	Flat rate	125,763	4.6
.	610	475	.. ..	Callender, J. & P. and Siemens, fdrs. conc. in e.w. casing, dist. single and 3-core*	£57,000	13,494	2251 eqv. 8-c.p.	326 H.P. ..	140 H.P.	36,245	12	Lg. 4½, pr. 3½ to 1, tr. 1·5, pb. lg. 1*	Flat rate and sliding scale	657,585	2.65
	470	210	Pfluger, 45 KW. for 10 hrs., max. dis. 270 KW.	Callender, conc. and triple conc. fdrs. in Sykes conduit, 3-core dist., jute, lead covd.; armd. and laid direct	£42,839	20,160	21 arc, 9·7 Nernst	36=265 H.P.	..	28,475	54	Lg. 5, pb. lg. 1·5, pr. 2 & 1½	Flat rate with discounts	328,040	3.69
	1,200	730	Pritchetts & Gold, lg.: E.P. S. tr.; max. dis. 150 KW.	B. I. & H. Co., ppr. lead covd., solid, also dist. armd. 3-core laid direct.	£64,898	33,296	104 arc, 87 inc., 12 N.	108=500 H.P.	..	47,150	17.5	Lg. 7 & 2 or 4, pr. lg. 7 & 1½, pr. 1½	Max. demand & flat rate	1,060,888	2.78
	375	180	A. B. P., max. dis. 200 KW. .	St. Helens Cable Co., Dialite, laid solid in wood. ..	£27,000	7,000	14 arc, 85 inc., 38 Nernst	13=23 H.P. ..	..	7,482	28	Lg. 5, pr. 3 to 2	Flat rate	14,014	4.61
	1,025	740	Tudor & Chloride; lg. 198 KW.: tr. 168 KW., max. dis.	B.I. & H., and Anchor, ppr., conc., lead covd.; dist. triple conc.	£92,555	37,321	66 arc, 136 inc. & Nernst	90=416 H.P.	28=652 H.P.	71,441	..	Lg. 6 & 3, or lg. pr. 3 & 1½, or 2, to 2 to 1½	Max. demand & flat rate	837,474	3.3
x	2,200	916	.. ..	Callender, v. bit. single, solid, conc. & triple conc. & B.I. & H. triple conc.; Callender dist. lead covd. & armd. conc.	£137,226	54,278	182 arc, 6 inc., 2 Nernst	56=63 H.P.		60,228	..	Lg. 5, pb. lg. arc £24, inc. £6, pr. 1..	Flat rate & two-rate, Sunday	980,407	..
	850	450	Baker, Bauer; max. dis. 100 KW.	Callender, 3-core ppr. and v. bit., in Howard troughing; dist. do., laid solid	£36,000	4,361	25 arc, 50 inc.	44=231 H.P.	20=748 H.P.	36,28..	..	Lg. 6 & 2 arc £16, pr. 3 & 1, tr. 1½	Max. demand	449,583	1.76
	550	310	.. ..	B.I. & H., conc., ppr., lead covd.	£62,552	20,447	17 arc, 36 inc.	5=13 H.P. ..	..	30,920	39	Lg. 5, pr. 2 & 1½ arc, £20	Flat rate ..	377,581	5½ pence & ½ penny
	860	560	.. ..	V. r. in ducts, and ppr. B.I. & H., 2 and 3-core.. ..	£94,204	41,692	3 arc., 564 inc.	22=92 H.P.	..	45,047	..	Lg. 5½, pr. 2	Flat rate	756,470	4.18
	3,400	2,243	E. P. S., max. dis. 400 KW. ..	Callender, single vulc. bit., solid, and drawn into e.l. and e'ware pipes	£262,410	127,328	4 arc, 29 inc.	2,106 H.P.	..	180,846	11	Lg. 6 & 1, pr. 2½ & 1* ..	Max. demand & flat rate	2,290,872	2.89
	180	78	D.P., max. dis. 96 KW. ..	Callender, fibre lead covd. and steel armd., fdrs. conc., dist. 3-core; single core v.b., wire armd. under river	£23,500	4,815	17 arc, 34 inc., 8 Nernst	24=82 H.P. ..	..	7,450	28	Lg. 7 & 4, pr. 4 & 1½ arc £17 p.a.	Max. demand & flat rate	87,401	4.4
	650	383	Tudor, 23 KW. for 10 hrs. ..	B.I. & H., fdrs. triple cone.; dist. 3-core; ppr., lead covd. and armd.	£53,000	11,500	48 arc, 512 inc. 10 Nernst	22=50 H.P.	..	24,800	20	Lg. 7, 2 & 1½, arc £2 5 inc. £8 & £4 6, pr. 2*	Max. demand & flat rate	..	..
	A.C. 300 D.C. 300	..	Hart, max. dis. 200 KW. ..	Anchor Cable Co., lead covd., conc. paper and v. bit. for tr., triple conc. paper for ltg.	£15,800	..	150 inc., 110 Nernst	..	24=700 H.P.	..	..	Lg. 6, pr. 6 and 2 ..	Flat rate and max. demand	..	..
r	1,375	652	E. P. S., max. dis. 400 KW. ..	Callender, fibre, ld. covd.; fdrs. solid, dis. armd. direct	£118,172	57,374	58 arc ..	67=332 H.P.	..	66,374	32	Lg. 6, 3 & 1½, or 5, pr. 2½ to 1½	Max. demand, flat rate and scale	770,421	3.76
	300	186	Accumulatoren A.G., max. dis. 75 KW.	Callender, fdrs. conc. (single neutral), dist. 3-core ..	£29,416	12,507	248 inc., 50 Nernst	..	62=165 H.P.	15,440	Ltg. lg. 45 total 93	Lg. 7 & 2, or 5, pr. .., pr. & tr. 2	Max. demand, flat & cont.	100,308	3.02
5	5,760	4,350	E. P. S. & Tudor, max. dis. 144 KW.	Callender, v. bit., solid	£665,424	233,854	..	585=1,770 H.P.	.	284,163	14.3	Lg. 6 & 4, pr. 3 & 2 & 1½ ..	Flat rate with discount	4,645,027	3.72
r	4,518	2,100	E. P. S., max. dis. 200 KW. ..	Siemens, Glover, and B.I. & H. v. r. and ppr. fdrs.; ppr. and v. r. dist., various makers	£235,700	67,004	207 arc, 432 inc.	270=1,150 H.P.	1,700 H.P.	137,068	12.12	Lg. 6 & 3, or 4, pb. lg. 2, pr. 1½ to 1, tr. 1½	Max. demand & flat rate	3,139,217	2.01
	3,250	1,900	Hart, max. dis. 175 KW. ..	H.p. fdrs. twin, l.p. conc. and single, ppr., solid, B.I. & H. and St. Helens	£180,000	58,338	208 arc, 496 inc.	48=384 H.P.	122=2,214 H.P.	118,418	..	*Lg. 6 & 2, or 5, pr. .. 3, pr. 2½, tr. 2 to 1½	Max. dem., flat rate and scale	2,561,695	2.87
	720	..	Tudor, 210 amp.-hours ..	Bare overhead, & Glover conc. and armoured	£23,000	7,000	170 arc & inc.	2=5 H.P. ..	700 H.P.	27,700	..	Lg. 4, pr. 4, tr. 1½ & 1	Flat rate & contract	..	..
	400	..	Chloride, 40 KW. for 5 hrs. ..	Callender, single cables laid solid	£25,000	..	..	..	..	..	..	Lg. 5½ to 4, pr. 2½ to 1½ ..	Flat rate & sliding scale	..	..
	5,000	2,685	.. ..	B.I. & H., D.C. fdrs. triple conc., A.C. fdrs. conc. Dist. 3-core jute ld. covd. armd. direct or 3 single ppr. solid	£255,897	122,696	8 arc ..	351=2,820 H.P.	..	192,150	11	Lg. 4 & 1, or 4, pr. 2½ to 1, less 10 per cent., tr. 1.1	Max. demand & flat rate	3,458,629	1.64
	2,050	1,029	Chloride, max. dis. 500 KW...	B.I. & H., Callender, St. Helens Cable Co., laid solid..	£104,140	29,587	166 arc, 1,451 eqvts. 8 c.p.	719 H.P. ..	325 KW. ..	61,850	..	Lg. 6 & 2, or 3½, pb. lg. 2, pr. 2 to 1, tr. 1½ to 1	Flat rate & max. demand	2,114,257	1.76
	200	54	Chloride, max. dis. 240 KW.	B.I. & H. lead covd., fdrs. in Sykes conduits, dist. laid solid		2,500	..	2=20 H.P. ..	..	4,000	..	Lg. 5, pb. lg. & pr. 2½ ..	Flat rate & contract	..	4
	3,610	1,485	Chloride, max. dis. 206 KW., Tudor, 45 KW. (sub. stn.)	Fdrs. conc., paper, B.I. & H., Siemens, Glover, Callender; dist. triple conc., Callender, Glover; in ducts and direct	£318,294	111,946	110 Nernst ..	68=116 H.P.	34=850 H.P.	145,000	13.5	Lg. 7 & 3[4], or 6, pr. 3, w. dis., pb. lg. Nernst £2.5	Max. demand & flat rate	1,703,329	4.7
	8,680	6,382	E. P. S., 400 KW. for 6 hrs ..	Ppr. lead covd., armd., also solid for tramway fdrs. Mainly B.I. & H.	£576,315	157,204	53 arc ..	1,244 6,112 H.P.		322,227 ex. tr.	..	Lg. 4, arc £12[6], pr. 2 to 1, tr. 2, tr. 1	Flat rate	14,733,951	1.552
	320	108	.. ..	B.I. & H., Callender, & Glover, ppr., lead covd. conc. laid direct	£15,000	6,700	31 arc, 200 inc.	..	..	7,187	..	Lg. 6 & 2[4], pb. lg. £10 & £2, pr. 6 & 3[4]	Max. demand	142,055	4
	282	79	D. P., 300 amp.-hrs.	Callender, fdrs. conc., dist. 3-core	£20,000	9,024	250 inc., 4 Nernst	9=47 H.P. ..	..	12,081	65	Lg. 6 & 4, or 5[4], pr. 4 & 1[4], or 2[4]	Max. demand & flat rate	75,017	4.48
	200	30	Hart, max. dis. 150 KW. ..	Western Electric, ppr. lead covd. armd., fdrs. triple conc., dist. 3-core	£23,000	2,000	..	4=7 H.P.	..	2,178	..	Lg. 7, 4 & 2, or 6 w. 25 per cent. dis., pr. 2	Max. dem. & flat rate w. dis.	..	4[4]
	220	102	E. P. S., 480 amp.-hours ..	Anchor Cable Co., ppr. lead covd. armd., triple conc., 3-core and twin	£27,000	6,724	704 arc, 1,156 inc., 55 Nernst	3=9 H.P. ..	..	8,857	..	Lg. 5 to 4, arc £15, Nernst £5, pr. 3 to 2	Sliding scale	11,820 1 month	..
	40	40	Chloride, max. dis. 28 KW. ..	Glover and St. Helens, insulated, overhead	£2,258	2,500	..	20	..	3,000	.	Lg. 6, pr. 5 ..	Flat rate ..	20,150	..
	6,135	4,534	Tudor, 400 amp.-hrs., lighting E. P. S., 1,200 amp-hrs., tr.	Triple conc. and single, armd. direct, and solid ..	£339,602	..	372 arc, 3,260 inc., 4 Nernst	288=1,081 H.P.	80=2,400 H.P.	284,000	5.1	Lg. 7 & 1, tr. 1[4] ..	Max. demand & flat rate	..	..
	7,032	4,279	E. P. S., max. dis. 70 KW. ..	Siemens and B.I. & H., jute and paper, fdrs. conc. armd. dist. triple conc.	£589,000 approx.	235,783	677 arc, 8 inc.	2,197 K.W.		274,166	17.11	Lg. 5 to 3[4], w. dis., pr. 14 arc £14, £19 & £21	Lg. 2 rate inc. pr. inc. & flat	5,217,728	2.36
	800	380	Pritchetts & Gold, 40 KW. for 10 hrs.	Callender, fdrs. triple conc., dist. 3-core	£81,725	27,414	..	20=155 H.P.	..	31,280	..	Lg. 7 & 4, pr. 4 & 1 ..	Max. demand	419,000	4.7
	90	50	E. P. S., 450 amp-hrs. ..	Callender, single, laid solid in wood	£13,000	8,604	12 arc, 36 inc.	8=37 H.P. ..	..	9,956		Lg. 6, pr. 4, pb. lg. 2[4]	Flat rate	64,181	
	70	..	27 KW. for 10 hours	Overhead	..	1,400	10 inc. ..	2=1½ H.P. ..	..	..		Lg. 7	Flat rate	..	
	1,500	1,247	Tudor, lg. 66 KW., tr. 250 KW. max. dis.	Fdrs. armd. and solid, dist. solid, various makers ..	£85,604	37,223	110 eq. 8 c.p.	181 H.P. ..	46=3,460 H.P.	122,207		Lg. 4, pb. lg. 3, pr. 3 & 1, tr. 1[4]	Flat rate & max. demand	1,730,578	2.32
	1,610	Lg. 427, tr. 250	.. ..	B.I. & H. and Silvertown, fdrs. conc. and single, dist. conc., solid and in iron pipes and Sykes cond.	£71,079	27,071	1 arc ..	49=210 H.P.	40=1,000 H.P.	53,100	21.8	Lg. 5, tr. 6 & 3, pr. 3 & 1, or 2 & 1, tr. 2 to 1[4]	Max. demand, flat rate & sl. scale	987,031	2.43
	1,240	1,158	E. P. S., lg. 132 KW., tr. 22 KW., for 1 hr.	V.r. and v. bit., lead covd., in e.l. and stoneware pipes and solid	£77,553	20,078	63 arc, 36 inc.	99=581 H.P.	..	44,139	9	Lg. 5 to 4, arc £14—£16, pr. 2[4] & 1, tr. 1.2	Max. demand, flat rate & sliding scale	1,280,471	2.89
	232	165.5	E. P. S., max. dis. 200 KW. ..	Callender, triple conc. and 3-core armd.	£27,748	6,104	14 arc, 405 inc.	13=75 H.P.	Water works 50 H.P.	10,401		Lg. 6, pr. 3 to 2[4], arc £13, inc. 35s.	Flat rate with discount	250,022	2.07
	538	234	Tudor, 250 amp.-hrs.	Callender, conc., jute, lead covd. and armd., laid direct	£41.5 0	14,935	30 arc ..	16=72 H.P.		20,955		Lg. 6, 4 & 3, or 7 & 3, arc £20, pr. 3 & 1	Sliding scale	225,180	4.46
	480	286	Chloride, max. dis. 200 KW. for lg., 200 KW. for tr.	Callender, v. bit., laid solid	£40 529	11,908	2 arc, 170 inc., 6 Nernst	24=200 H.P.	20=500 H.P.	30,160		Lg. 7 & 4, pr. 4 & 1, tr. 1[4]	Max. demand & contract	507,207	2
	1,500	616	.. ..	Paper ins., fdrs. twin, dist. 3-core	£101,461	43,013	1 arc ..	..	..	47,112		Lg. 6 on 2.0 v., 7 on 100 v.	Flat rate and contract	581,208	5.6
	110	..	.. ..	Glover, armd. direct and in Howard troughs	..	..	..	..	..	..		Lg. 4, pr. 2 ..	Flat rate	..	
	900	350	Pritchetts & Gold, max. dis. 130 KW.	Western Elec. triple conc., lead covd. and armd., direct, also Siemens & Henley	£59,894	19,393	12 arc, 439 inc., 36 Nernst	38=108 H.P.	..	23,952	-	Lg. 7 & 2, or 5, arc £20, inc. £3[4], pr. 3 to 1[4]	Max. demand, flat rate & sliding scale	32,187	4.7
	1,560	918 A.C. 795 D.C.	Tudor, max. dis. 500 KW.	Siemens and B.I. & H., v. r. conc., ppr., armd.. ..	£189,134	84,548	420 arc, 115 inc.	120=532 H.P.	..	109,570		Lg. 7 & 2, or 4[5], pr. 4 & 1, pb. lg. 1[4]	Max. demand, flat rate & sliding scale	2,285,472	2.99
	870	521	Tudor	Callender, conc. v. bit. lead covd., armd. direct and solid; B. I. & H. single solid in e. l. troughs	£53,650	27,506	48 arc, 20 Nernst	60=150 H.P.	30=450 H.P.	30,400		Lg. 5 to 4, pr. 2, tr. 1, to 1[4] arc £23 & £15	Sliding scale & flat rate	704,446	2.6
	115	..	Chloride, 40 KW. for 4 hrs. ..	H.p. p r. in ducts; and covd. overhead: l.p. covd. overhead	..	..	13 arc, 80 inc.	1=67 H.P. ..	..	3,500		Lg. 6 & 3[4]	Flat rate with discount	..	..
	200	..	.. ..	British Insulated & Helsby Cables	..	..	..	..	..	..		Lg. 5, pr. 2[4], w. dis.	Flat rate	..	
	88	41	D.P., max. dis. 43 KW. ..	Callender, fdrs. triple conc. armd.; dist. lead covd., steel taped, 3-core	£20,000	1,634	..	..	..	1,634		Lg. 7 & 4, pr. 4 & 1[4] ..	Max. demand		
	22	19	.. ..	B.I. & H., ppr., lead covd.	..	..	21 inc. ..	..	..	..		Lg. 6, pb. lg. £2 p.a. ..	Flat rate	..	..
	865	374	Chloride, max. dis. 36 KW. ..	Henley h.p. conc., ppr., armd., laid direct; dist., v.r. and ppr. conc.	£57,437	14,829	320 arc, 1,120 inc.	34=141 H.P.	..	19,562		Lg. 6[5], pr. 3, pb. lg. £25 and £6	Flat rate with discount	77,724	4.01
	1,700	750	Tudor, 60 KW. for 3 hrs. ..	Callender, bit. fibre	£133,032	34,556	331 arc, 19 inc.	7=40 H.P. ..	..	..		Lg. 6 & 3[4], pr. 3, tr. 1.9 to 1	Max. demand	..	..
	100	..	Hart, 46 KW.	Silvertown, v. rubber, laid solid	..	..	..	..	..	..		Lg. 7, pr. 3	Flat rate	..	..
	250	116	Tudor, 115 KW.	Callender, bit. laid solid; lead covd. and armd. laid direct	£24,000	2,293	9 arc, 88 inc., 72 Nernst	23=118 H.P.	..	6,646		Lg. 7 & 4, or 6, pr. 4 & 1[4] or 2	Max. dem., flat rate & cont.	89,551	3.2
	1,300	905	E. P. S., 110 KW., and Tudor, 125 KW. for 1 hr.	Callender, bit. fibre, lead covd. and armd., conc. and triple conc.	£110,906	46,386	3,087 arc, 1,103 inc., 43 N.	112=221 H.P.	24=600 H.P.	71,039	6.15	Lg. 4[5], pb. lg. 2.504, pr. 2 to 1[8], tr. 1[4]	Flat rate ..	1,335,960	2.77
	1,000	610	Chloride, max. dis. 150 KW...	B. I. & H. conc. and triple conc., solid throughout ..	£50,000	16,700	20 arc, 40 inc.	63=356 H.P.	24=600 H.P.	37,900 ex. tr.	41	Lg. 6 & 3, or 4, arc £12[5], pr. 1[4] & 1[4], tr. 1[4]	Max. demand & flat rate	522,149	2.87
	80	50	D. P., 20 KW. for 5 hrs. ..	Callender, fdrs. triple conc., dist. 3-core	£20,000	6,600	..	..	..	6,600		Lg. 8 & 4	Max. demand	..	..
	921	396	Tudor, 132 KW.-hrs.	B.I. & H., triple conc, and J. & P., fdrs. drawn in, dist. solid	..	21,642	..	286 H.P. ..	..	29,658	13.7	Lg. 5, pr. 2[4] to 1[4] ..	Flat rate ..	461,171	3.84
	200	..	Tudor, max. dis. 85 KW. ..	3-wire, single, sheathless, solid in Howard troughs ..	..	1,421	930 Nernst..	..	..	2,372		Lg. 7 & 3[4], or 6, pb. lg. Nernst £2.5, pr. 3 w. dis.	Max. demand, flat rate, etc.	1,703,824	4.7
	800	410	E. P. S., max. dis. 115 KW. ..	B.I. & H., fdrs. triple conc., dist. 3 single laid solid in wood troughs	£24,000	1,310	3 arc ..	17=60 H.P.	500 H.P. ..	17,125	12	Lg. 4, pb. lg. 2, pr. 2 & 1, tr. 1.5 to 1.3	Flat rate & sldg. scale	380,728	2.24
	800	450	Tudor, 480 amp.-hrs.	Callender, fdrs. three single, dist. triple conc.	..	30,197	22 arc, 214 inc.	137½ H.P. ..	..	38,500		Lg. 5, pr. 2[5]*	Flat rate	..	
	1,280	692	E. P. S., 300 KW. hrs. & Hart, max. dis. 294 KW.	Siemens & Henley, lead covd. jute, fdrs. in conduits; dist., 3-core, armd.	£59,582	28,953	32 inc., 263 Nernst	30=105 H.P.	32=768 H.P.	52,798	112.5	Lg. 5 & 4[5], pr. 4 to 2[4], pb. lg. 2[4], tr. 2	Flat rate & scale	790,807	2.87
	770	..	.. ..	B.I. & H. and Glover, fdrs. triple conc., dist. 3-core, ppr., lead covd.	£34,000	9,884	..	43=87 H.P.	12=336 H.P.	12,059	24	Lg. 6 & 2[5], or 4[5], pr. 3 & 1, or 2[5], tr. 1[4] & 1[2]	Max. demand & flat rate	383,550	2.54
	315	200	Tudor, max. dis. 44 KW ..	Glover, ppr., diatrine, lead covd., armd. direct	£18,000	15,000	33 arc ..	3=13 H.P....	..	15,300	40	Lg. 5, pr. 3	Flat rate ..	145,406	1.89
	1,850	1,007	Tudor, 1,700 amp.-hrs. ..	B.I. & H., lead covd. ppr., Callender lead covd. and armd., jute, and Siemens	£138,983	39,126	85 arc ..	171=1,185 H.P.	70=1130 H.P.	103,715	8	Lg. 5, 4 & 3, pr. 2 to 1[4], pb. lg. £15	Max. demand & sl. scale	2,461,571	..
	1,800	526	.. ..	B.I. & H. and Siemens, ppr., lead covd., conc.; fdrs. solid, dist. armd. direct and in pipes	£102,712	39,605	40 arc ..	58=346 H.P.	..	48,700	..	Lg. 6, 3, 1, pr. 1[4] ..	Max. demand & flat rate	566,731	3.32
	540	270	D. P., max. dis. 144 KW. .	Henley, ppr. & v. r. lead covd. in wood troughs ..	£48,500	16,310	8 arc, 714 posts (inc.)	18=65 H.P.	..	19,990	10	Lg. 6 & 3, or 4, pr. 3 to 1[2], pb. lg. 3	Max. demand & flat rate	411,364	3.2
	190	..	Hart, max. dis. 175 KW. ..	Callender, v. bit. 3 single, laid solid in wood troughs ..	..	7,816	10 arc., 20 inc.	5=8 H.P. ..	..	8,220	91	Lg. 7 & 4, or 6, pr. 4 & 1[2], or 2[4], pb. lg. 2[4]	Max. demand & flat rate	53,240*	5.21*
	4,165	2,161	Tudor, max. dis. 50 KW. (exciting)	Callender, v.b. fibre and paper	£231,343	116,838	410 arc, 37 inc. 50 Nernst	309 H.P. ..	120=4,200 H.P.	238,285	8.5	Lg. 7 & 1[2], or 5, pr. (t. sw.) 5 & 1[2], or 2[4], tr. 2	Max. demand & flat rate	..	..
	692	610	D. P., max. dis. 48 KW.; E. P. S., max. dis. 170 KW.	Callender, fdrs. conc., dist. triple conc.; lead covd. solid in wood & armd. direct	£55,228	25,178	54 arc ..	54=242 H.P.	32=800 H.P.	58,782	148	Lg. 4[5] to 4, pb. lg. £16 2, pr. 2 to 1[2], tr. 1[4]	Sldg. sc., flat rate & cont.	721,368	2.739
	500	..	A. B. P., 50 KW. for 3 hrs. ..	Fdrs. triple conc., dist. 3-core, all ppr. lead covd. solid	£34,000	6,000	6 arc, 340 inc.	..	..	6,430	..	Lg. 7 & 2, or 5, pr. 2[5]* ..	Max. demand & flat rate	..	..
	180	89	D. P., max. dis. 168 KW. ..	Callender, v.-bit., lead covd., armd.	£44,235	8,781	10 arc, 144 inc. 9 Nernst	13=37 H.P.	..	10,305	55	Lg. 7 & 4 or 6, pr. 4, & 1[4] or 2[4]*	Max. demand & flat rate	123,189	3.38
	900	780	Tudor, 500 amp.-hrs.	Callender, armd. fdrs. and dist., also Doulton conduit	£55,224	12,242	18 arc, 150 inc	192 H.P. ..	980 H.P. ..	46,054	..	Lg. 4[5], pr. 3, tr. 1[4], pb. lg. 3	Flat rate ..	618,104	2.36
	3,200	1,600	Chloride, max. dis. 320 KW. ..	B.I. & H., Callender, Glover & Siemens; paper and jute conc., and single bit. solid	£175,500	71,787	141 arc, 490 inc.	249=1,278 H.P.	50=1,000 H.P.	148,684	39.2	Lg. 6 & 3, or 4[4] to 3[4], pr. 3 to 1, or 1[4], tr. 1[4]*	Max. demand & sl. scale	2,034,800	2.7
	1,860	Lg. 300, tr. 550	A. B. P., max. dis. 460 KW. E. P. S., max. dis 1,000 KW.	Callender, v. bit. lead covd. and armd., and solid ..	£163,522	16,764	20 arc, 1 inc.	18=202 H.P.	76=1,900 H.P.	69,618	..	Lg. 4[5] & 4, pr. 2[4], tr. 3 to 1[4]*	Sldg. sc., flat rate & cont.	1,642,246	2.217
	1,000	Lg. 333, tr. 300	Tudor, 90 amp. for 4 hrs. ..	Fdrs. 3 and 2 conc. and 3-core v. b. dist. single, all lead covd., armd. direct. Siemens, Callender, B.I. & H.	£53,170	20,363	31 arc, 32 inc.	57=238 H.P.	*	26,345 ex. tr.	..	Lg. 5[4] & 3[4], pr. 3 & 1, tr. 1[4] & 1.4	Max. demand & sldg. scale	881,879	2.44
	48	22	Chloride, max. dis. 40 KW. ..	Overhead, bare copper	..	1,200	..	5=8 H.P. ..	..	1,330	..	Lg. 8 & 6, pr. 4 & 1, tr. 1.5	Max. demand & flat rate	..	..
	909	606	E.P.S., max. dis. 23 KW. ..	Callender, fdrs. fibre, single, lead covd.; dist. armd. ..	£45,700	25,720	1 arc ..	266 H.P. ..	1,300 H.P. ..	64,870	..	Lg. 5, 4[5] & 3, pb. lg. 3, pr. 2, tr. 1[2]	Max. demand & flat rate	859,919	2.54
	180	82.9	D. P. max. dis. 50 KW. ..	Armd. a. d so'i t	£26,000	7,564	..	3=5 H.P. ..	..	7,660	8	Lg. 7 & 4, pr. 2[4]	Max. demand	38,553*	5.8
	1,650	610	Tudor, max. dis. 77 KW. ..	Fdrs., v.r. conc., Silvertown; dist. ppr. conc., lead covd., B.I. & H. and Glover in pipes	£167,016	32,143	40 arc; inc. & N. = 407 8-c.p.	45=350 H.P.	34=850 H.P.	..	..	Lg. 7 & 3, or 6 w. dis., tr. 2[4], pr. 2[4]*	Max. dem. & flat rate w. dis.	1,208,061 (15 mon.)	1.64
	4,500	2,000

REVIEW" LIST OF ELECTRICITY SUPPLY W

Pressure and supply, volts.	Frequency and Phase.	Boilers and Auxiliaries.	Engines.	Generators.	Total Capacity in KW.	Max. load recorded in KW.	Storage Battery.	Mains.	Tot cap exper
A 440	Direct	6 B. & W., 2 suphtrs. (Cotton St.).	3 Willans, 1 Belliss	2 E. C. C., 1 Crompton, 1 Mather & Platt	666	2,766	E.P.S., 20 KW. for 10 hrs.	Bare copper, bit. paper and jute in Crompton Davies casing, iron pipes, wdn. troughing, solid	£220,
7500		6 B. & W., suphtrs., ch. g. stokers, cond (Dee Village).	8 Willans (1 on order)	1 J. Lundell, 3 Mavor & Coulson, 2 Westinghouse, 1 Peebles, 2 Holmes	2,100		E.P.S., 90 KW. for 10 hrs.		
A 220	100~ 1-ph., & direct	3 Paxman Economic	4 Browett-Lindley, 2 Peache ..	2 Johnson & Phillips, A. C., 2 J. & P. D. C., 2 Brush arc.	240	140	.. ..	B.I. & H., armd. and lead covd., conc.	..
A 460	Direct	3 Lane., econ., cond.; 6-cell Horsfall destructor. .	3 Willans, 2 Browett-Lindley ..	3 J. & P., 2 Lanc. D. & M. Co. ..	535	256	Chloride, max. dis. 160 KW..	Glover and B.I. & H., single core ppr.; feeders solid, dist. armd. direct	£45,
A 460	Direct	Supply in Bulk from	Met. Elec. Supply Co.	2 E.C.C., 2 Lanc. D. & M. Co. (motor-generators)	780	..	E. P. S., 150 KW.	Dialite cables, laid solid in Howard troughing; St. Helen's Cable Co.	£50,
210	Direct	2 econ. (Paxman)	2 Belliss	2 Edison & Swan	92	65	D.P., 240 KW. hrs.	Callender, triple conc. fdrs., 3-core dist.; both lead covd. and armd.; laid direct	£25,
A 420	Direct ..	3 B. & W., econ., cond.	4 Willans	4 Parker	440	146	D.P., max. dis. 150 amp. .. Pritchetts & Gold on order	Callender feeders and distributors, single, laid solid ..	£24,
A 440	Direct ..	Supply in bulk	from the British	Electric Plant Co., Ltd.	..	58	.. ..	Callender, fdrs. 3-core, dist. single, v. bit., solid ..	£9.
A 460	Direct ..	2 B. & W., stokers and econ.	2 Ruston Proctor	2 Crompton	150	..	Chloride, 250 amp.-hrs. ..	Callender, single, solid, in wood troughs	£12,
100	80~ 1-ph.	6 Lane.	5 Browett-Lindley	5 Edison & Swan	660	446	.. ..	Feeders, Glover, v. r. in pipes; dist. B. I. & H.; lead covd. and armd.	£61,
A 480	Direct	4 Lane., 2 tubular, econ., 4-cell Horsfall destr. ..	3 Browett-Lindley, 2 Belliss	3 Jackson (Sayers), 3 Siemens ..	1,260	1,014	.. ..	Conc. paper and bitumen	£64,
A 440	Direct	6 B. & W., suphtrs., Vicars stokers, econ., 4-cell Hughes-Stirling destructor, Boby detart.	3 Ferranti, 1 Yates & Thom, 1 Belliss, 1 Reavell	2 Dick Kerr, 3 G. E. Co., 1 Westinghouse	2,265	820	.. ..	B.I. & H., triple conc. and 3-core, part in e'ware ducts, part solid	£95,
A ..	50~ 2-ph. & direct	Supply in bulk from	South Lancashire Electric	Traction & Power Co., Ltd.	..	..	.. ..	Callender, conc., ppr. ins. bit. solid in wood troughs ..	£10,
240 A	100~ 1-ph. & direct	4 Lane., 2 Stirling, 2 B. & W., Vicars and ch. g. stokers, 6-cell Meldrum destr.	7 Belliss, 1 Marshall	4 Siemens A. C.; 2 Bruce Peebles, 2 Siemens, D. C.	1,325	600	E. P. S., 30 KW. for 7 hrs. max. disch. 100 KW.	Callender, conc. armd., A.C. bit. solid, D.C. in wood ..	£87,
A 500	Direct	2 B. & W.	3 Parsons turbines	3 Parsons	369	87.6	Hart, max. dis. 14 KW. ..	Callender, fdrs. twin conc. v. bit., dist. 3-core, all laid solid	..
A 480	Direct	2 Horsfall water-tube, 2-cell Meldrum destr. ..	3 Willans	2 Fowler, 1 J. P. Hall	290	187	Hart, 35 KW. for 6 hrs. ..	B.I. & H. triple conc. ppr. lead covd. and armd. ..	£24,
A 460	Direct ..	4 B. & W., cond., dig. tr.	2 Sundon Forge, 3 Allen ..	2 S. Forge, 2 Thames Ironworks, 1 Siemens	610	475	.. ..	Callender, J. & P. and Siemens, fdrs. conc. in e.w. casing, dist. single and 3-core	£55,
A 480	Direct	4 B. & W., cond., fd. htr.	4 Belliss	4 Siemens	470	210	Pfluger, 45 KW. for 10 hrs., max. dis. 270 KW.	Callender, conc. and triple conc. fdrs. in Sykes conduit, 3-core dist., jute, lead covd.; armd. and laid direct	£42,
A 460	Direct	6 Lane., stokers, cond., econ.	7 Willans	4 J. & P., 3 Peebles	1,200	730	Pritchetts & Gold, lg.; E.P. S. tr.; max. dis. 150 KW.	B. I. & H. Co., ppr. lead covd., solid, also dist. armd. 3-core laid direct.	£64,
500	Direct	3 B. & W., suphtrs., econ., cond.	3 Reavell	3 Taunton	375	180	A. B. P., max. dis. 200 KW. ..	St. Helens Cable Co., Dialite, laid solid in wood. ..	£27,
A 440	Direct	5 B. & W., econ., cond., Boerman & Feenstra 4-cell dest.	3 Univ. .. 4 Willans ..	3 Brush, 2 Peebles, 2 Dick Kerr ..	1,025	740	Tudor & Chloride; lg. 198 KW.; tr. 168 KW., max. dis.	B.I. & H., and Anchor, ppr., conc., lead covd.; dist. triple conc.	£92,
100	100~ 1-ph. & direct	4 B. & W. land tupes, 1 B. & W. marine	4 Belliss, 2 Belliss & Wigzell, 4 Brast	2 E. C. C., 4 Mordey (rope-driven) & 4 Dick Kerr	2,200	916	.. ..	Callender, v. bit, single, solid, conc. & triple conc. & B.I. & H. triple conc.; Callender dist. lead covd. & armd. conc.	£137,
A 440	Direct	3 Lane., Proctor stokers, econ., cond., dig. tr., and 1 Lane. with 3-cell Horsfall destr.	4 Belliss	3 Fowler, 1 Westinghouse	850	450	Baker, Bauer: max. dis. 100 KW.	Callender, 3-core ppr. and v. bit., in Howard troughing; dist. do., laid solid	£35,
A 460	50~ 1-ph.	4 B. & W., petro., econ., de tart., 3-cell Horsfall dest.	3 Belliss, 1 Bennett-Lindley ..	3 Fowler, 1 Johnson & Phillips ..	550	310	.. ..	B.I. & H., conc., ppr., lead covd.	£62,
A 240	100~ 1-ph.	7 B. & W., 2 Lane., stokers, cond.	2 Belliss, 3 Allen	1 Johnson & Phillips, 2 Siemens, 3 Fynn	860	560	.. ..	V. r. in ducts, and ppr. B.I. & H., 2 and 3-core	£94,
A 440	Direct	6 Lane., Vicars Cortes, 6 B. & W., stokers, econ., feed htrs., cond., dig. tr.	11 Belliss	6 Parker, 6 M. & P., 1 J. & P. ..	3,400	2,243	E. P. S., max. dis. 400 KW. ..	Callender, single vulc. bit., solid, and drawn into c.i. and e'ware pipes	£262,
A 480	Direct	2 Sundon water tube	2 Belliss	2 Crompton	180	78	D.P., max. dis. 96 KW. ..	Callender, fibre lead covd. and steel armd., fdrs. conc., dist. 3-core; single core v.b., wire armd. under river	£23,
A 440	Direct	2 Horsley, 2 B. & W., suphtrs., 1 sup. fired, smokeless	3 Allen, 1 Belliss	3 Allen, 1 Brit. Westinghouse ..	650	383	Tudor, 23 KW. for 10 hrs. ..	B.I. & H., fdrs. triple conc.; dist. 3-core; ppr., lead covd. and armd.	£33,
500	50~ 1-ph.	3 Lane.	2 Browett-Lindley	Dick Kerr, 2 A.C., 2 D.C. (traction)	A.C. 300 D.C. 300	..	Hart, max. dis. 200 KW. ..	Anchor Cable Co., lead covd., conc. paper and v. bit. for tr., triple conc. paper for ltg.	£15,
A 460	Direct	4 Lane., Vicars stokers, 2 B. & W., chain gr. stokers	8 Willans, 1 Scott & Mountain ..	4 Crompton, 2 Siemens, 2 Mavor & Coulson, 1 Scott & Mountain	1,375	652	E. P. S., max. dis. 460 KW. ..	Callender, fibre, ld. covd.; fdrs. solid, dis. armd. direct	£118,
A 440	Direct	3 B. & W.	3 Browett-Lindley	3 Bruce Peebles	300	186	Accumulatoren A.G., max. dis. 75 KW.	Callender, fdrs. conc. (single neutral), dist. 3-core ..	£29,
A 440	Direct	20 Lane., 6 B. & W.	13 Willans, 9 Belliss, 2 Parsons turbines	4 Mather & Platt, 13 Crompton, 5 E. C. C., 2 Parsons	5,760	4,350	E. P. S. & Tudor, max. dis. 144 KW.	Callender, v. bit., solid	£665,
210 A	50~ 1-ph. & direct	12 Lane., stokers, econ., cond.	8 Willans, 7 Belliss	1 Mather & Platt, 7 Siemens, 3 Mavor & Coulson, 3 Dick Kerr	4,518	2,100	E. P. S., max. dis. 200 KW. ..	Siemens, Glover, and B.I. & H. v. r. and ppr. fdrs.; ppr. and v. r. dist., various makers	£235,
240 A	100~ 1-ph. & direct	5 Lane., 2 Proctor, 5 B. & W.	2 Fowler, 1 Ferranti, 7 Parsons turbine, 1 Browett Lindley	7 Parsons, 2 Fowler, 2 E. C. C., 1 Ferranti and 1 Westinghouse	3,250	1,900	Hart, max. dis. 175 KW. ..	H.p. fdrs. twin, l.p. conc. and single, ppr., solid, B.I. & H. and St. Helens	£180,
240 A	Direct	.. ..	Water turbines, by Gilkes, Cassell and Luther Wyse	6 Sandycroft Foundry	720	..	Tudor, 210 amp.-hours ..	Bare overhead, & Glover conc. and armoured	£23,
A 400	Direct	2 B. & W.	2 Allen	2 Crompton	400	..	Chloride, 40 KW. for 5 hrs. ..	Callender, single cables laid solid	£25,
200 A	50~ 1-ph. & direct	13 Lane., stokers, suphtrs., cond., dig. tr., econ.	6 Musgrave, 4 Hick Hargreaves ..	2 Dick Kerr, 4 Mather & Platt D.C., 4 Ferranti A.C.*	5,000	2,685	.. ..	B.I. & H., D.C., fdrs. triple conc., A.C. fdrs. conc. Dist. 3-core jute ld. covd. armd. direct or 3 single ppr. solid	£255,
200	Direct	8 Lane., stokers, cond., cond.	6 Belliss, 2 Ferranti	5 Parker, 1 E. C. C., 2 Bruce Peebles	2,050	1,029	Chloride, max. dis. 500 KW..	B.I. & H., Callender, St. Helens Cable Co., laid solid..	£104,
A 440	Direct	2 Horsman & Proctor water tube ..	2 Davey Paxman	2 Lane. D. & M. Co..	200	54	Chloride, max. dis. 240 KW.	B.I. & H. lead covd., fdrs. in Sykes conduits, dist. laid solid	..
240 A	100~ 1-ph. & direct	9 B. & W., cond., dig. tr.	7 Brush, 2 Browett-Lindley ..	2 Ferranti, 5 Brush A.C., 2 Brush D.C.	3,610	1,485	Chloride, max. dis. 206 KW.. Tudor, 45 KW. (sub. stn.)	Fdrs. conc., paper, B.I. & H., Siemens, Glover, Callender; dist. triple conc., Callender, Glover; in ducts and direct	£318,
A 460	Direct	4 Lane., timartite, ind. draught, stokers, 10 water-tube, suphtrs., econ., cond., dig. tr.	19 Willans, 1 Marshall, 2 Coir, Marden & Morley, 2 Musgrave	15 Siemens, 2 E. C. C., 2 Peebles, 4 Westinghouse, 1 Phoenix	8,680	6,382	E. P. S., 400 KW. for 6 hrs ..	Ppr. lead covd., armd., also solid for tramway fdrs. Mainly B.I. & H.	£576,
500	100~ 1-ph.	1 Lane., 2 Lane., cond., econ.	1 Belliss, 1 Easton-Anderson, 1 Browett Lindley, 1 Victor turbine	1 Witting, 1 International, 1 Easton-Anderson, 1 J. & P.	320	108	.. ..	B.I. & H., Callender, & Glover, ppr., lead covd. conc. laid direct	£15,
A 440	Direct	2 B. & W., suphtrs., feed htr. ..	3 Belliss	3 Parker	282	79	D. P., 300 amp.-hrs.	Callender, fdrs. conc., dist. 3-core	£20,
A 440	Direct	Dowson gas producer	2 British Westinghouse	3 British Westinghouse	200	30	Hart, max. dis. 150 KW. ..	Western Electric, ppr. lead covd. armd., fdrs. triple conc., dist. 3-core	£23,
A 460	Direct	2 Lane.	2 Allen	2 Johnson & Phillips	220	102	E. P. S., 480 amp.-hours ..	Anchor Cable Co., ppr. lead covd. armd., triple conc., 3-core and twin	£47,
100	Direct	.. ..	3 Crossley gas	3 Brook	40	40	Chloride, max. dis. 28 KW. ..	Glover and St. Helens, insulated, overhead	£2,
240 A	Direct	6 Lane., 10 B. & W.	18 Willans	2 Goodden, 2 Siemens, 3 Crompton, 3 Peebles, 8 E. C. C.	6,135	4,584	Tudor, 400 amp.-hrs., lighting. E. P. S., 1,200 amp-hrs., tr.	Triple conc. and single, armd. direct, and solid ..	£339,
500	50~ 1-ph. & direct	11 B. & W., 2 Lane., stokers, suphtrs., cond.	19 Willans, 3 Parsons turbine ..	13 Siemens, 4 Dick Kerr, 2 Parsons, 1 Peebles	7,032	4,279	E. P. S., max. dis. 70 KW. ..	Siemens and B.I. & H., jute and paper, fdrs. conc. armd. dist. triple conc.	£589,
500	Direct	1 Paxman Economic cond.	6 Belliss	6 Parker	800	380	Pritchetts & Gold, 40 KW. for 10 hrs.	Callender, fdrs. triple conc., dist. 3-core	£81,
240 A	Direct	2 B. & W., suphtrs., cond.	2 Belliss	2 Parker	90	50	E. P. S., 450 amp-hrs. ..	Callender, single, laid solid in wood	£13,
500	Direct	1 Marshall (steam), and Dowson suction gas prod.	1 Marshall (steam), 1 National & 1 Grice gas engines	1 Greenwood & Batley, 2 Elwell-Parker, 1 Johnson & Phillips	70	..	27 KW. for 10 hours	Overhead	..
500	Direct	3 Lane., stokers, econ.	3 Burnley Iron Works, 4 Belliss ..	3 Parker, 2 E.C.C., 2 Dick Kerr ..	1,500	1,247	Tudor, lg. 66 KW., tr. 250 KW. max. dis.	Fdrs. armd. and solid, dist. solid, various makers ..	£85,
500	100~ 1-ph.	6 Lane., econ., cond., 7 Cole, etc., 1 Pennis stoker	3 Fowler, 1 Alley & Macellan, 4 Willans	3 Fowler, 1 Brown-Boveri, 1 Bruce Peebles, A.C.; 3 B. T. H., D.C.	1,610	Lg. 427, tr. 250	.. ..	B.I. & H. and Silvertown, fdrs. conc. and single, dist. conc., solid and in iron pipes and Sykes cond.	£71,
500	Direct	.. ..	6 Belliss	6 Siemens	1,240	1,158	E. P. S., lg. 132 KW., tr. 22 KW., for 1 hr.	V.r. and v. bit., lead covd., in c.i. and stoneware pipes and solid	£77,
500	Direct	2 Lane., Horsley stokers, econ.	3 Belliss	3 Fowler	232	165.5	E. P. S., max. dis. 200 KW. ..	Callender, triple conc. and 3-core armd.	£27,
500	Direct	6 Horsley	6 Belliss	6 M. & P., 2 Sunderland Forge, 1 E. C. C.	538	234	Tudor, 250 amp.-hrs.	Callender, conc., jute, lead covd. and armd., laid direct	£41,
500	Direct	2 Lane., 1 B. & W., suphtrs.	4 Belliss	5 Parker	480	286	Chloride, max. dis. 200 KW. for lg., 200 KW. for tr.	Callender, v. bit., laid solid	£40,
500	100~ 1-ph.	11 Lane., econ., cond.	7 Parsons turbines	7 Parsons	1,500	616	.. ..	Paper ins., fdrs. twin, dist. 3-core	£101,
500	Direct	2 Lane., Arrol-Meldrum dest.	Howden	Parker	110	..	.. ..	Glover, armd. direct and in Howard troughs	..
500	Direct	4 Lane., Proctor stokers, 1 Paxman Economic, 1 B. & W., with 2-cell Boerman & Deas destr.	5 Belliss	6 Silvertown, 2 Johnson & Phillips, 2 Dick Kerr	900	350	Pritchetts & Gold, max. dis. 130 KW.	Western Elec. triple conc., lead covd. and armd., direct, also Siemens & Henley	£59,
500	50~ 1-ph. & 3-ph.	6 B. & W., suphtrs., cond.	2 Paxman, 3 Belliss, 1 Ferranti ..	5 Siemens, 1 Ferranti	1,560	918 A.C. 795 D.C.	Tudor, max. dis. 500 KW. ..	Siemens and B.I. & H., v. r. conc., ppr., armd.	£189,
500	Direct	2 Lane., stokers, econ., cond.	6 Willans	2 Peebles, 4 Siemens	870	521	Tudor	Callender, conc. v. bit. lead covd., armd. direct and solid; B. I. & H. single solid in c. i. roughs	£53,
500	50~ 1-ph.	1 B. & W.	1 Belliss; 2 Waverley, 1 Vortex, turbines (water)	2 E. C. C., A. C.; 3 Laurence Scott, D.C.	115	..	Chloride, 40 KW. for 4 hrs. ..	H.p. p r. in ducts; and covd. overhead: l.p. covd. overhead	..
500	Direct	2 Economic	2 Peache	2 Lane. D. & M. Co.	200	..	.. ..	British Insulated & Helsby Cables	..
500	Direct	2 Sundon	2 Belliss	2 G.E.C.	88	41	D.P., max. dis. 43 KW. ..	Callender, fdrs. triple conc. armd.; dist. lead covd., steel taped, 3-core	£20,
500	100~ 1-ph.	.. ..	Water Wheel	2 Siemens	22	19	.. ..	B.I. & H., ppr., lead covd.	..
500	100~ 1-ph.	2 Lane., 3 B. & W., ch. g. stokers ..	5 Willans, 1 Peache	8 Crompton	865	374	Chloride, max. dis. 36 KW. ..	Henley h.p. conc., ppr., armd., laid direct; dist., v.r. and ppr. conc.	£57,
500	100~ 1-ph. & direct	1 Lane., 6 B. & W., econ.	3 Willans, 4 Belliss, 2 Parsons turbines	5 Siemens (2 D.C., 3 A.C.), 2 Parsons A.C., 2 Witting D.C.	1,700	750	Tudor, 60 KW. for 3 hrs. ..	Callender, bit. fibre	£133,
500	Direct	2 Paxman boss	2 Peache	2 Silvertown	100	..	Hart, 46 KW.	Silvertown, v. rubber, laid solid	..
500	Direct	2 Paxman Economic	2 Peache	2 British Westinghouse	250	116	Tudor, 115 KW.	Callender, bit. laid solid; lead covd. and armd. laid direct	£24,
500	Direct	7 B. & W., stokers	7 Belliss	6 Parker, 1 Mather & Platt	1,300	905	E. P. S., 110 KW., and Tudor, 125 KW. for 1 hr.	Callender, bit. fibre, lead covd. and armd., conc. and triple conc.	£110,
500	Direct	6 B. & W., econ.	5 Belliss	5 Westinghouse	1,000	610	Chloride, max. dis. 150 KW..	B. I. & H. conc. and triple conc., solid throughout ..	£50,
500	Direct ..	.. ..	.. ..	2 Parker motor transformers ..	80	50	D. P., 20 KW. for 5 hrs. ..	Callender, fdrs. triple conc., dist. 3-core	£20,
500	Direct	4 Economic, forced draught	5 Peache	5 Johnson & Phillips	921	396	Tudor, 132 KW.-hrs.	B.I. & H., triple conc, and J. & P., fdrs. drawn in, dist. solid	..
500	Direct	2 B. & W.	2 Belliss	2 Siemens	200	..	Tudor, max. dis. 85 KW. ..	3-wire, single, sheathless, solid in Howard troughs ..	..
500	Direct	4 Lane. (2 fired by 4-cell Meldrum destructor)	3 Belliss, 1 Gourlay	3 Johnson Lundell, 1 Phœnix ..	800	410	E. P. S., max. dis. 115 KW. ..	B.I. & H., fdrs. triple conc., dist. 3 single laid solid in wood troughs	£24,
500	Direct	3 Lane., cond.	2 Browett-Lindley, 2 Belliss	2 Brush, 2 Mavor & Coulson ..	800	450	Tudor, 480 amp.-hrs.	Callender, fdrs. three single, dist. triple conc.	..
500	Direct	5 Paxman Economic, cond.	7 Peache	5 Siemens, 2 Mather & Platt ..	1,280	692	E. P. S., 300 KW. hrs. & Hart, max. dis. 294 KW.	Siemens & Henley, lead covd. jute, fdrs. in conduits; dist., 3-core, armd.	£59,
500	Direct	2 Lane., stokers, suphtrs., econ., cond. 1 B. & W. with 2 cell Boerman & Deas dest.	1 Parsons turbine, 3 Belliss	1 Parsons, 2 Greenwood & Batley, 1 Bruce Peebles	770	..	.. ..	B.I. & H. and Glover, fdrs. triple conc., dist. 3-core, ppr., lead covd.	£34,
500	Direct	2 B. & W.	3 Browett-Lindley, 1 Stockport (gas)	4 Bertram Thomas	315	200	Tudor, max. dis. 44 KW ..	Glover, ppr., diatrine, lead covd., armd. direct	£18,
500	Direct	7 B. & W.	2 Allis, 3 McIntosh & Seymour, 1 Belliss, 1 Curtis	7 B. T. H.	1,850	1,007	Tudor, 1,700 amp.-hrs. ..	B.I. & H., lead covd, ppr., Callender lead covd. and armd., jute, and Siemens	£138,
500	50~ 1-ph. & 50~ 2-ph.	4 Lane., stokers, econ., cond.	3 Fowler, 1 Belliss, 2 McLaren ..	2 Fowler, 1 Fynn, 1-ph 2 British Schuckert, 2-ph.	1,800	526	.. ..	B.I. & H. and Siemens, ppr., lead covd., conc.; fdrs. solid, dist. armd. direct and in pipes	£102,
500	Direct	3 Lane., stokers, econ., cond.	3 Willans	3 Mather & Platt	540	270	D. P., max. dis. 144 KW. ..	Henley, ppr. & v. r. lead covd. in wood troughs ..	£48,
500	Direct	2 Sundon water tube, suphtrs.	2 Belliss	2 Parker	190	..	Hart, max. dis. 175 KW. ..	Callender, v. bit. 3 single, laid solid in wood troughs ..	..
500	100~ 1-ph. & direct	5 Paxman, 6 B. & W., 2 Danks multitub., 3 elg. brs., suphtrs., econ.	11 Belliss	9 B.T.H., 1 E.C.C., 1 Dick Kerr ..	4,165	2,161	Tudor, max. dis. 50 KW. (exciting)	Callender, v.b. fibre and paper	£231,
500	Direct	4 Lane.	4 Scott & Mountain, 2 Allen ..	6 Scott & Mountain, 2 Parker ..	692	610	D. P., max. dis. 48 KW.; E. P. S., max. dis. 170 KW.	Callender, fdrs. conc., dist. triple conc.; lead covd. solid in wood & armd. direct	£55,
500	Direct	3 Lane., stokers, cond.	3 Reavell	2 G. E. Co., 1 Lane. D. & M. Co. ..	500	..	A. B. P., 50 KW. for 3 hrs. ..	Fdrs. triple conc., dist. 3-core, all ppr. lead covd. solid	£34,
500	Direct	2 B. & W., suphtrs., Boby heater	2 Belliss	2 Parker	180	89	D. P., max. dis. 168 KW. ..	Callender, v.-bit., lead covd., armd.	£44,
500	Direct	4 Lane., stokers, cond., Meldrum 2-cell destructor	4 Belliss	2 Siemens, 1 Mather & Platt, 1 Peebles	900	780	Tudor, 500 amp.-hrs.	Callender, armd. fdrs. and dist., also Doulton conduit	£55,
500 A	100~ 1-ph. & direct	6 Lane., 5 B. & W., econ.	3 Ferranti, 5 Browett-Lindley, 3 Parsons turbines	3 Ferranti, 5 Siemens, 3 Parsons ..	3,200	1,600	Chloride, max. dis. 320 KW. ..	B.I. & H., Callender, Glover & Siemens; paper and jute conc., and single bit. solid	£175,
500 A	Direct	5 B. & W., cond., feed htrs., econ.	1 Browett-Lindley, 3 Ferranti, 1 Willans.	5 E. C. C.	1,860	Lg. 300, tr. 550	A. B. P., max. dis. 460 KW. E. P. S., max. dis 1,000 KW.	Callender, v. bit. lead covd. and armd., and solid ..	£169,
500 A	440	4 Lane., econ.	7 Willans, 1 Belliss	3 Crompton, 2 Peebles, 1 Dick Kerr, 3 Siemens	1,000	Lg. 333, tr. 300	Tudor, 90 amp. for 4 hrs. ..	Fdrs. 3 and 2 conc. and 3-core v. b. dist. single, all lead covd., armd. direct. Siemens, Callender, B.I. & H.	£53,
500	Direct	.. ..	2 Stockport (gas)	1 Prentice, 1 Anglian	48	22	Chloride, max. dis. 40 KW. ..	Overhead, bare copper	..
500	Direct	4 Lane., stokers	7 Willans	7 Mather & Platt, and Bruce Peebles	909	606	E.P.S., max. dis. 23 KW. ..	Callender, fdrs. fibre, single, lead covd.; dist. armd. ..	£45,
500	Direct ..	B. & W.	2 Belliss	2 Parker	180	82.9	D. P. max. dis. 50 KW. ..	Armd. a. d so'i t	£26,
500	100~ 1-ph. & direct	6 B. & W., econ., cond.	4 Brush, 2 Macintosh & Seymour, 1 Ball & Wood, 1 Ferranti, 1 Parsons	1 Ferranti, 4 Brush, 1 Parsons A.C.; 3 G.E.C. (Am.), D.C.	1,650	610	Tudor, max. dis. 77 KW. ..	Fdrs., v.r. conc., Silvertown; dist. ppr. conc., lead covd., B.I. & H. and Glover in pipes	£167,
500	50~, 1-ph. & 3-ph.	4 B. & W., 6 Lane.	4 Stewart, 1 Belliss	4 Oerlikon, 1 G.E. Co.	4,500	2,000	.. ..	Callender and B.I. & H., conc. and 4-core	£433,
230 A	Direct	6 B. & W., stokers fd. htrs., econ., cond., Thermal	4 Westinghouse, 2 Ferranti	4 Westinghouse, 2 E.C.C.	1,600	Lg. 388, tr. 850.	.. ..	Callender triple conc., lead covd., and v. bit, solid ..	£70,
Baker son .. 200 &	500	Direct ..	8 Lanc., cond., feed htrs., econ., 2 B. & W., stokers	11 Willans	1 Dick Kerr, 6 Siemens, 3 Parker, 1 Int. E. E. Co.	3,010	2,190	E. P. S. max. dis. 70 KW. ..	B.I. & H. & Callender; fdrs., single ld. covd., & v.bit. dist., l. covd., ppr., v. bit., in Doulton con., also armd. direct	£176,
cement nam.) Knight 102 &	240 & 4	Direct ..	2 B. & W., 1 Woodeson (Clarke, Chapman) suphtrs.	3 Brush	3 Brush	400	172	Hart, 240 amp.-hrs.	Callender, solid	£26,
gas ..	200	40~, 1-ph.	6 Lanc., 4 stokers, cond., 1 Stirling	7 Browett-Lindley, 3 Belliss, 1 Davey-Paxman	Siemens, 8 A.C., 3 arc (1,800 V. D. C.)	1,000	1,003	Tudor, max. dis. 94 KW. ..	Callender, Siemens and J. & P., jute (h.p.) and v. bit. (l.p.)	£173,
		50~, 1-ph. & 3-ph.	2 Stirling, 2 Hornsby, 1 Economic, 1 B. & W. ..	3 Ferranti, 2 Willans, 1 Peache	3 Ferranti, 3 E.C.C.	1,200	875	.. ..	Glover fdrs. and dist., ppr. conc. solid; and St. Helens twin dist.	£148,

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LY WORKS OF THE UNITED KINGDOM.

	Total capital expended.	Private lighting, eqvt. 8 c.p. lamps.	Public lighting.	No. and H.P. of private motors.	No. and H.P. of traction motors.	Total connections of all kinds, eqvt. 8 c.p. lamps.	Percentage increase during year.	Price charged per unit, pence.	System of charging.	Units sold during last complete year.	PENCE PER UNIT SOLD. Av. price obtained.	Working costs.	Total costs.	Remarks.	
rompton Davies id	£220,743	103,434	289 arc	408=1720 H.P.	138=3,450 H.P.	154,100, excl. tr. traction	21.8	Lg. 6 & 2½, pb. lg. 6 & 2, pr. 3 & 1, tr. (corp.) 1.97, (co.) 2¼	Max. demand, except for tr.	3,539,026	2.49	.81	1.07	Lg. and tr.; Willans-Peebles 420 KW. set on order for Dee village. Results are for year ending 31/7/04.	1
.. .. ..	..	9,795	29 arc, 1 inc.	..	..	10,250	..	Lg. 6	Flat rate ..	..	..	..	..	Public lighting by contract	2
; feeders solid,	£45,707	18,631	16 arc, 62 inc. 87 Nernst	43=195 H.P.	..	25,439	17.1	Lg. 4, pb. lg. 3, pr. 3 & 1	Flat rate ..	312,205	3.03	1.106	1.648	.. ..	3
troughing; St.	£50,000	..	..	..	..	10,000	..	Lg. 5, pr. 2	Flat rate ..	..	..	..	..	Supply in bulk at 10,000 volts, converted to D.C. by motor generators	4
st.; both lead	£25,600	9,026	..	1=2 H.P. ..	..	9,026	20	Lg. 7 & 4, pr. 2½	Max. demand & flat rate	60,624	4.7	1.91	3.32	.. ..	5
e, laid solid ..	£24,500	..	17 arc, 18 inc., 3 Nernst	9=23 H.P. ..	..	9,270	..	Lg. 6 & 4 or 5, pb. lg. 2½, pr. 3 & 2	Max. demand and flat	..	..	..	..	.. ..	6
t., solid ..	£9,500	2,800	20 arc ..	7=9 H.P. ..	..	3,325	..	Lg. 7 & 3, pr. 2	Max. demand	58,500	..	..	..	.. ..	7
.. .. ..	£12,000	..	..	..	..	..	..	Lg. 5½ to 4, pr. 2½ to 1¼ ..	Sliding scale	..	..	..	..	.. ..	8
. I. & H.; lead	£61,884	38,676	..	7=30 B.H.P.	..	47,670	6.72	Lg. 6, pr. 3	Flat rate and contract	396,997	5.25	2.256	3.016	.. ..	9
.. .. ..	£64,662	19,746	98 arc, 130 inc. 1 Nernst.	36=144 H.P.	120=3,000 H.P.	100,582	..	Lg. 4, pb. lg. 1.6, pr. 1.5 to 0.9, tr. 1.5 to 1.0	Flat rate and sliding scale	1,805,530	1.69	0.62	0.82	Lg. and tr. Energy supplied to four tramway undertakings	10
n c'ware ducts,	£95,000	21,913	15 arc, 30 inc.	52=409 H.P.	36=1,800 H.P.	80,921	..	Lg. 3½ to 2½, or 6 & 1½, pr. 2 to 1, tr. 1½*	Max. dem., sl. sc., & 2-ra. inc.	..	..	about 1.00	..	Lg. & tr. *Destructor plant, 100 KW., as stand-by. † Pb. lg. £12 per lamp p.a.	11
od troughs ..	£10,000	2,300	..	12=194 H.P.	..	6,956	..	Lg. 5, pr. & tr. 1½ ..	Flat rate ..	..	4.84	..	..	Lg. and tr.	12
.c. in wood ..	£87,525	36,500	121 arc, 155 inc., 10 N.	31=83 H.P.	32=800 H.P.	41,060	70	Lg. 5, pr. & p. l. 2, tr. 1.3	Flat rate ..	1,047,781*	2.45	1.03*	1.33	Lg. and tr. *Units sold and costs given for year ending May 15th, 1904	13
3-core, all laid	..	..	2 arc, 4 inc., 3 Nernst	7=55½ H.P.	..	7,500	..	Lg. 7 & 2½, pb. lg. 1.8, pr. 1.5	Max. demand	60,246	4.4	..	..	.. ..	14
d armd. ..	£24,222	9,013	..	8=19½ H.P.	..	9,497	8.2	Lg. 5, pr. 2½	Flat rate ..	124,763	4.6	2.62	2.8	Coke fuel, 12- per ton. Electy. dept. overcharged for destructor steam	15
conc. in c.w.	£57,000	13,494	2251 eqv. 8 c.p.	325 H.P. ..	440 H.P.	36,245	12	Lg. 4½, pr. 3½ to 1, tr. 1·5, pb. lg. 1·8	Flat rate and sliding scale	697,585	2.65	1.4	1.6	Lg. & tr. *Call. & Siemens 3-core ld. ed armd., ppr. ins., to outer area.	16
Sykes conduit, d laid direct so dist. armd.	£42,839	20,160	21 arc, 9·67 Nernst	36=265 H.P.	..	28,175	54	Lg. 5, pb. lg. 1½, pr. 2 & 1½	Flat rate with discounts	328,060	3.69	1.13	1.68	Running without battery for 3½ months somewhat increased the costs	17
	£61,808	33,396	104 arc, 87 inc., 12 N.	108=500 H.P.	..	47,195	17.5	Lg. 7 & 2 or 4, pb. lg. 7 & 1½, pr. 1½	Max. demand & flat rate	1,009,888	2.78	.649	.881	.. ..	18
n wood. ..	£27,000	7,000	14 arc, 85 inc., 38 Nernst	13=23 H.P.	..	7,982	28	Lg. 5, pr. 3 to 2 ..	Flat rate ..	145,014	4.61	2.02	2.89	.. ..	19
d covd.; dist.	£92,555	37,321	66 arc, 136 inc. & Nernst	90=416 H.P.	28=652 H.P.	71,341	..	*Lg. 6 & 3, or 4½, pr. 3 & 1½, or 2, tr. 2 to 1½	Max. demand & flat rate	837,454	3.3	1.082	1.411	Lg. and tr. *Pb. lg. arc £17½, inc. £3 & £2½	20
le cone. & B.I. d. & armd. conc.	£137,226	54,278	182 arc, 6 inc., 2 Nernst	56=63 H.P.	..	60,228	..	Lg. 5, pb. lg. arc £24, inc. £6, pr. 1½	Flat rate & two-rate m. w. dis.	989,407	..	..	..	Supply by company 1890-7	21
rd troughing;	£33,069	4,361	25 arc, 50 inc.	44=231 H.P.	20=748 H.P.	33,283	..	Lg. 6 & 2, arc £16, pr. 3 & 1, tr. 1½	Max. demand	449,583	1.76	.86	1.15	Lg. and tr.	22
. .. ..	£62,552	20,447	17 arc, 36 inc.	5=13 H.P. ..	..	33,929	39	Lg. 5, pr. 2 & 1½, arc. £20	Flat rate ..	377,583	5½ private 3 public	2.25	2.78	*Free wiring 6d.	23
3-core.. ..	£94,204	41,692	3 arc., 564 inc.	22=92 H.P.	..	45,165	..	Lg. 5½, pr. 2	Flat rate ..	756,470	4.19	1.93	2.32	.. ..	24
n into c.i. and	£262,810	127,328	4 arc, 29 inc.	2,106 H.P. ..	..	189,846	11	Lg. 6 & 1½, pr. 2½ & 1· ..	Max. demand & flat rate	2,290,872	2.89	.800	1.189	Lg. and tr. *Pr. special, 1d. with time switch. Arc £15, inc. £2½	25
l.. fdrs. conc., d. under river e: ppr., lead	£23,500	4,815	17 arc, 34 inc., 8 Nernst	24=82 H.P.	..	7,320	28	Lg. 7 & 4, pr. 4 & 1½, arc £17 p.a.	Max. demand & flat rate	57,301	4.4	1.92	3.05	.. ..	26
	£33,000	11,500	48 arc, 512 inc. 10 Nernst	22=50 H.P.	..	24,910	20	Lg. 7, 2 & 1½, arc £2 5, inc. £8 & £4.6, pr. 2*	Max. demand & flat rate	..	..	..	..	Dept. meters 6d. per unit	27
and v. bit. for	£15,800	..	150 inc., 110 Nernst	..	24=600 H.P.	..	..	Lg. 6, pr. 6 and 2 ..	Flat rate and max. demand	..	..	..	..	Lg. & tr.	28
armd. direct	£118,172	57,374	58 arc ..	67=332 H.P.	..	66,374	32	Lg. 6, 3 & 1½ or 5, pr. 2½ to 1¼	Max. dem., flat rate and scale	759,421	3.76	1.03	1.49	Sep. tramway plant. Pb. lg. arc £1·8½ p.a.	29
. 3-core ..	£29,416	12,507	248 inc., 50 Nernst	..	62=165 H.P.	15,446	Tr. lg. 45 total 33	Lg. 7 & 2, or 5, pb. lg., pr. & tr. 2	Max. demand, flat, & cont.	199,308	3.02	1.485	2.680	Lg. and tr.	30
.. .. ..	£665,424	293,854	..	585=1,770 H.P.	..	258,644	14.3	Lg. 6 & 4, pr. 3, 2 & 1½ ..	Flat rate with discount	4,645,027	3.62	1.11	1.58	Battery in sub-station only. Results to March 31, 1905.	31
pr. fdrs: ppr.	£235,700	67,094	207 arc, 432 inc.	270=1,150 H.P.	1,700 H.P. ..	155,689	12.12	Lg. 6 & 3, or 4, pb. lg. 2, pr. 1½ to 1, tr. 1½	Max. demand & flat rate	3,129,215	2.04	.63	1.0	Lg. and tr.	32
ppr., solid,	£180,000	58,338	268 arc, 496 inc.	48=384 H.P.	122=2,214 H.P.	118,418	..	*Lg. 6 & 2, or 5, pb. lg. 3, pr. 2½, tr. 2 to 1½	Max. dem., flat rate and scale	2,561,033	2.85	1.17	1.448	Lg. and tr. *Special day tariff 1½d. per unit	33
red	£20,000	7,000	170 arc & inc.	2=5 H.P. ..	700 H.P.	27,500	..	Lg. 4, pr. 4, tr. 1½ & 1	Flat rate & contract	..	..	..	..	Lg. & tr.	34
.. .. ..	£25,000	..	..	..	..	..	..	Lg. 5½ to 4, pr. 2½ to 1¼	Flat rate & sliding scale	..	..	..	..	.. ..	35
s. conc. Dist. gle ppr. solid .. laid solid ..	£255,897	122,096	8 arc ..	351=2,820 H.P.	..	192,105	11	Lg. 4 & 1, or 4, pr. 2 to 1, less 10 per cent., tr. 1.1	Max. demand & flat rate	5,458,629	1.64	.527	.652	Lg. & tr. To 800 k.w. motor generators also installed	36
	£104,140	29,587	166 arc, 1,451 equiv. 8 c.p.	719 H.P. ..	325 K.W. ..	61,850	..	Lg. 6 & 2, or 3½, pb. lg. 2, pr. 2 to 1, tr. 1½ to 1	Flat rate & max. demand	2,114,257	1.76	.72	.82	Lg. and tr.	37
nits, dist. laid	..	2,500	..	2=20 H.P. ..	..	3,000	..	Lg. 5, pb. lg. & pr. 2½ ..	Flat rate & contract	..	4	..	..	.. ..	38
r, Callender; cts and direct anway fdrs.	£318,294*	111,946	110 Nernst ..	68=116 H.P.	34=850 H.P.	145,996	13.5	Lg. 7 & 3¼, or 6, pr. 3, w. dis., pb. lg. Nernst £2.5	Max. demand & flat rate	1,703,329	4.7	1.64	2.34	Lg. & tr. *Including Christchurch ..	39
	£576,315	157,204	53 arc ..	1,244=6,112 H.P.	..	322,267 ex. tr.	..	Lg. 4, arc £12½, pr. 2 to 1½, htg. 2, tr. 1	Flat rate ..	13,783,651	1.552	.613	.934	Lg. & tr.; lamps free. *Inc. .02d. for free lps., and .102 for hiring dept.	40
covd. conc.	£15,000	6,700	31 arc, 209 inc.	..	..	7,185	..	Lg. 6 & 2½, pb. lg. £10 & £2, pr. 6 & 3½	Max. demand	142,055	4	2.6	3.8	.. ..	41
.. ..	£20,000	9,029	250 inc., 4 Nernst	9=47 H.P. ..	..	12,081	65	Lg. 6 & 4, or 5½, pr. 4 & 1½, or 2½	Max. demand & flat rate	75,015	4.48	1.9	3.0	*Harold Hale, Engineer & Secretary ..	42
fdrs. triple	£23,000	2,000	..	4=7 H.P. ..	..	2,196	..	Lg. 7, 4 & 2, or 6 w. 25 per cent. dis., pr. 2	Max. dem. & flat rate w. dis.	..	4½	..	..	1st year incomplete	43
triple conc.,	£27,000	6,724	704 arc, 1,156 inc., 55 Nernst	3=9 H.P. ..	..	8,855	..	Lg. 5 to 4, arc £15, Nernst £5, pr. 3 to 2	Sliding scale,	11,823 (1 month)	..	1.068	2.088	Data given for first month's running	44
.. ..	£2,258	2,500	..	20	..	3,000	..	Lg. 6, pr. 5	Flat rate ..	26,250	..	..	..	.. ..	45
solid ..	£339,602	..	372 arc, 3,260 inc., 4 Nernst	288=1,081 H.P.	80=2,400 H.P.	284,000	5.1	Lg. 7 & 1, tr. 1½	Max. demand & flat rate	..	..	..	..	Lg. and tr.	46
e. conc. armd.	£589,000 (approx.)	235,783	677 arc, 8 inc.	2,197 K.W. ..	..	274,166	17.11	Lg. 5 to 3½, w. dis., pr. 1¼ & ¼ are £14½, £19 & £21	Lg. 2-rate m., pr. m. d. & flat	5,217,528	2.96	.967	1.374	.. ..	47
.. ..	£81,725	27,414	..	20=155 H.P.	..	31,280	.	Lg. 7 & 4, pr. 4 & 1 ..	Max. demand	419,000	4.7	1.45	2.02	Feeds Chislehurst through step-up transformers, at 2,000 volts	48
.. ..	£13,000	8,604	12 arc, 36 inc.	8=37 H.P. ..	..	9,956	.	Lg. 6, pr. 4, pb. lg. 2½ ..	Flat rate ..	64,181	..	..	..	.. ..	49
... ..	..	1,400	10 inc. ..	2=1½ H.P. ..	..	..	.	Lg. 7	Flat rate ..	..	..	..	..	Gas plant installed July, 1904	50
akers ..	£85,604	37,223	110 eq. 8 c.p.	181 H.P. ..	46=3,460 H.P.	122,207		Lg. 4, pb. lg 3, pr. 3 & 1, tr. 1½	Flat rate & max. demand	1,739,795	2.32	.764	1.020	Lg. and tr.	51
single, di-t. cond. eware pipes	£71,679	27,071	1 arc ..	49=210 H.P.	40=1,000 H.P.	58,100	21·8	Lg. 5, or 6 & 3, pr. 3 & 1, or 2 to 1½, tr. 2 to 1½*	Max. dem., flat rate, & sl. scale	985,933	2.42	0.99	1.31	Lg. & tr. Pb. lg. .5d. 100 k.w. being installed to supply Ashby-Bur.on Ld. Ry.	52
	£77,553	29,078	638 arc. 36 inc.	99=581 H.P.	..	44,199	56	Lg. 5 to 4, arc £14—£16, pr. 2½ & 1, tr. 1.2	Max. dem., flat rate & sl. scale	1,280,461	2.09	.59	.83	Lg. and tr.	53
.. ..	£27,748	6,104	14 arc, 405 inc.	13=75 H.P.	Water works 50 H.P.	10,401		Lg. 6, pr. 3 to 2½, arc £13. inc. 35s.	Flat rate with discount	256,022	2.67	1.44	1.83	Corporation water works supplied at 1.75d. per unit	54
.. laid direct	£41,5 0	14,905	30 arc ..	16=72 H.P.	..	20,955		Lg. 6, 4 & 3, or 7 & 3, arc £20, pr. 3 & 1¼	Sliding sc., or max. dem.	226,189	4.46	1.99	2.89	Max. load at end of summer; load through season heavier than in winter	55
	£40,529	11,908	2 arc, 170 inc., 6 Nernst	24=200 H.P.	20=500 H.P.	30,160	15	Lg. 7 & 4, pr. 4 & 1. tr. 1½	Max. demand & contract	507,237	2	.9	1.16	Lg. and tr.	56
.. ..	£101,461	43,913	1 arc ..	..	..	47,112		Lg. 6 on 230 v., 7 on 100 v.	Flat rate and contract	523,298	5.6	1.62	2.5	Data to Dec. 31st, 1904	57
.. .. ..	..	..	..	..	..	..	..	Lg. 4, pr. 2*	Flat rate ..	..	..		..	Proposed works not running yet (June 1905)	58
rnd., direct.	£59,894	19,393	12 arc, 439 inc., 36 Nernst	38=108 H.P.	..	23,952		Lg. 7 & 2, or 5, arc £25, inc. £3½, pr. 3 to 1½	Max. dem., flat rate & sl. scale	32,358	3.7	1.6*	2.18	*.31d. due to purchase of new battery out of revenue	59
nd.. ..	£189,134	84,548	420 arc, 115 inc.	120=532 H.P.	..	109,570	..	Lg. 7 & 2, or 4½, pr. 4 & 1, pb. lg. 1½	Max. dem., flat rate & prept.	2,385,472	2.95	1.2	1.5	Centre of town & docks, sup. by D.C. from tramway dept.	60
direct and ghs	£53,650	27,506	48 arc, 20 Nernst	60=150 H.P.	30=450 H.P.	30,409	50	Lg. 5 to 4, pr. 2, tr. 1½ to 1¼, arc £23 & £15*	Sliding scales & flat rate	704,446	2.6	1.33	1.81	Lighting and traction. Also lg. £7 per K.W. & 2d. per unit	61
l.p. covd.	..	..	13 arc, 80 inc.	1=67 H.P. ..	..	3,500		Lg. 6 & 3½	Flat rate with discounts	..	..	..	..	5 miles overhead to Carlow, driving mo. dynamo. Steam plant at C. as stand-by	62
.. .. ..	..	..	.	. ..	..	..		Lg. 5, pr. 2½, w. dis. .	Flat rate ..	..	..	..	..	Supply commenced March 2nd, 1905 ..	63
l covd., steel	£20,000	1,634	..	..	..	1,634	12	Lg. 7 & 4, pr. 4 & 1½ ..	Max. demand	..	5.5	..	..	.. ..	64
.. ..	..	..	21 inc. ..	..	..	..		Lg. 6, pb. lg. £2 p.a. ..	Flat rate ..	..	..	..	..	.. ..	65
; dist., v.r.	£57,437	14,829	320 arc. 1,120 inc.	34=141 H.P.	..	19,562	7.5	Lg. 6½, pr. 3, pb. lg. £25 and £5s.	Flat rate with discount	77,524	4.01	1.84	2.52	.. ..	66
.. ..	£133,082	34,556	391 arc, 19 inc.	7=40 H.P. ..	..	..		Lg. 6 & 3½, pr. 3, tr. 1.9 to 1	Max. demand	..	..	..	..	Lighting A.C., Tramway Co. supplied with D.C.	67
.. ..	..	..	..	..	..	..		Lg. 7, pr. 3	Flat rate ..	..	..	..	..	.. ..	68
armd. laid	£24,000	2,293	9 arc, 88 inc., 72 Nernst	23=118 H.P.	..	6,646		Lg. 7 & 4, or 6, pr. 4 & 1½, or 2*	Max. dem., flat rate & cont.	89,551	3.2	1.2	1.7	Arc £20 & £14, Nernst £2½ glow £2	69
, conc. and	£110,905	46,386	3,087 arc, 1,103 inc., 43 N.	112=221 H.P.	24=600 H.P.	71,039	6·15	Lg. 4½, pb. lg. 2.504. pr. 2 to 1½, tr. 1½	Flat rate ..	1,335,960	2.77	.802	1.163	Lg. and tr.	70
ghout ..	£50,000	16,700	20 arc, 40 inc.	63=356 H.P.	24=600 H.P.	37,900 ex. tr.	41	Lg. 6 & 3, or 4. arc £12½, pr. 1½ & 1¼, tr. 1½	Max. demand & flat rate	522,149	2.87	.81	1.18	Lg. and tr.	71
.. ..	£20,000	6,600	..	..	..	6,600	..	Lg. 8 & 4	Max. demand	..	..	..	..	Fed from Bromley at 2,000 v.	72
wn in, dist.	..	21,642	..	286 H.P. .	..	29,658	15.7	Lg. 5, pr. 2½ to 1½ ..	Flat rate ..	461,171	3.84	1.41	2.0	.. ..	73
oughs ..	..	1,421	939 Nernst..	..	..	2,372	.	Lg. 7 & 3½, or 6, pb. lg. Nernst £2.5, pr. 3 w. dis.	Max. demand, flat rate, etc.	1,703,329	4.7	1.64	2.34	See Bournemouth..	74
aid solid in	£24,000	1,310	3 arc ..	17=60 H.P.	500 H.P. ..	17,125	12	Lg. 4, pb. lg. 2, pr. 2 & 1, tr. 1.5 to 1.3	Flat rate & sldg. scale	389,728	2.24	.736	1.106	Lg. and tr.	75
. .. ..	..	30,197	22 arc, 214 inc.	137½ H.P. ..	..	38,500		Lg. 5, pr. 2½*	Flat rate ..	..	..	..	..	* Large works 1½d. & 1d.	76
conduits;	£59,582	28,953	32 inc., 263 Nernst	30=105 H.P.	32=768 H.P.	52,798	112.5	Lg. 5 & 4½, pr. 4 to 2½, pb. lg. 2½, tr. 2	Flat rate & scale	799,807	2.87	1.42	1.7	Lg. and tr.	77
3-core, ppr.,	£34,000	9,884	..	43=87 H.P.	12=336 H.P.	12,059	23	Lg. 6 & 2½, or 4½, pr. 3 & 1, or 2½, tr. 1½ & 1½	Max. demand & flat rate	383,550	2.54	1.01	1.36	Lg. and tr.	78
:	£18,000	15,000	33 arc ..	3=13 H.P. ..	..	15,300	40	Lg. 5, pr. 3	Flat rate ..	145,406	4.89	1.77	2.48	.. ..	79
covd. and	£138,983	39,126	85 arc ..	171=1,185 H.P	70=1130 H.P.	103,715	8	Lg. 5, 4 & 3, pr. 2 to 1½, pb. lg. £15	Max. demand & sl. scale	2,461,571	..	.74	1.26	Lg. and tr.	80
onc.; fdrs.	£102,712	39,605	40 arc ..	58=346 H.P.	..	48,700	..	Lg. 6, 3, 1, pr. 1½ ..	Max. demand & flat rate	566,731	3.32	1.024	1.513	Extensions in progress	81
hs ..	£48,500	16,310	8 arc, 714 posts (inc.)	18=65 H.P.	..	19,890	10	Lg. 6 & 3, or 4, pr. 3 to 1½, pb. lg. 3	Max. demand & flat rate	411,364	3.2	0.9	1.3	.. ..	82
troughs ..	..	7,816	10 arc., 20 inc.	5=8 H.P. ..	..	8,220	91	Lg. 7 & 4, or 6, pr. 4 & 1½, or 2½, pb. lg. 2½	Max. demand & flat rate	53,230*	5.23*	..	..	Slot meter, 7d. per unit, inc. rent. * To end of Dec., 1904	83
.. ..	£231,343	116,838	410 arc, 37 inc. 50 Nernst	309 H.P. ..	120=4,200 H.P.	238,285	8.5	Lg. 7 & 1½, or 5, pr. (t. sw.) 5 & 1½, or 2½, tr. 2*	Max. demand & flat rate	..	..	..	..	Lg. and tr. * Pb. lg. arc £18, inc. £3½	84
lead covd.	£55,228	25,178	54 arc ..	54=242 H.P.	32=800 H.P.	58,782	148	Lg. 4½ to 4, pb. lg. £16 2, pr. 2 to 1½, tr. 1½	Sldg. sc., flat rate & cont.	721,368	2.739	.707	.98	Lg. and tr.	85
covd. solid	£34,000	6,000	6 arc, 340 inc.	..	..	6,430	..	Lg. 7 & 2, or 5, pr. 2½* ..	Max. demand & flat rate	..	..	..	..	* Prepayment meters, rate 6d.	86
.. ..	£44,235	8,781	10 arc, 144 inc. 9 Nernst	13=37 H.P.	..	10,305	55	Lg. 7 & 4 or 6, pr. 4. & 1½ or 2½*	Max. demand & flat rate	123,189	3.38	2.3	2.74	† Pb. lg. £480 p.a. in all	87
n conduit	£55,224	12,242	18 arc, 150 inc	192 H.P. ..	980 H.P. ..	46,054	..	Lg. 4½, pr. 3, tr. 1¾, pb. lg. 3	Flat rate ..	618,104	2.36	.94*	1.185	Lg. and tr. * Pb. lg. charged to Highways Committee ..	88
paper and	£175,500	71,787	141 arc, 490 inc.	249=1,278 H.P.	50=1,000 H.P.	148,684	30.2	Lg. 6 & 3, or 4½ to 3½, pr. 3 to 1, or 1¼, tr. 1½*	Max. demand & sl. scale	2,034,800	2.7	1.07	1.36	*Pb. lg., arc £24, inc. 33s.	89
olid ..	£109,522	16,764	20 arc, 1 inc.	18=202 H.P.	76=1,900 H.P.	69,618	..	Lg. 4½ & 4, pr. 2¼, tr. 3 to 1½*	Sldg. sc., flat rate & cont.	1,642,246	2.217	.77	.972	Lg. and tr. * Pb. lg., arc £22½, inc. 3⅜ p.a.	90
le, all lead .I. & H.	£53,170	20,363	31 arc, 32 inc.	57=238 H.P.	*	26,345 ex. tr.	..	Lg. 5½ & 3½, pr. 3 & 1, tr. 1½ & 1.4	Max. demand & sldg. scale	881,879	2.44	1.0	1.31	Lg. and tr. * Supply to Yorkshire (Woollen District) Elec. Tramway.	91
.. ..	..	1,200	..	5=8 H.P. ..	..	1,330	..	Lg. 8 & 6, pr. 4 & 1, tr. 1.5	Max. demand & flat rate	..	..	..	..	Lg. and tr.	92
armd. ..	£45,700	25,720	1 arc ..	266 H.P. ..	1,300 H.P. ..	64,870	..	Lg. 5, 4½ & 3, pb. lg. 3, pr. 2, tr. 1½	Max. demand & flat rate	859,919	2.54	.9	1.17	Lg. and tr.	93
.. ..	£26,000	7,564	..	3=5 H.P. ..	..	7,660	8	Lg. 7 & 4, pr. 2½	Max. demand	38,553*	5.3	..	..	* Nine months only, to December, 1904	94
onc., lead	£167,016	82,143	40 arc; inc. & N.=407 8-c.p.	45=350 H.P.	34=850 H.P.	..	..	Lg. 7 & 3, or 6 w. dis., tr. 2½, pr. 2½*	Max. dem. & flat rate w. dis.	1,298,061 (15 mon.)	1.64	3.54	1.93	Lg. and tr. Data to Mar. 31st, 1905 (15 mon.) *Pb. lg. arc £30 p.a., inc. 2½d. p.u.	95
.. ..	£433,000	90,000	500 arc ..	70=250 H.P.	..	95,000	20	Lg. 7 & 2½, pb. lg. arc £22 p.a., pr. 7 & 1	Max. demand	2,668,743	..	..	..	.. ..	96
solid ..	£70,728	21,896	80 arc, 222 inc, 16 Nernst	52=233 H.P.	..	31,934*	29	Lg. 6 & 1½, or 5, pr. 6 & 1½, tr. 2 to 1	2-rate meter, & flat rate	1,505,971	..	..	..	Lg. and tr. † Pb. lg. £20 & 2d. ..	97
v.bit. dist., rnd. direct	£175,451	75,023	71 arc ..	203=815 H.P.	122=3,410 H.P.	181,177	9.26	Lg. 4 & 3, pr. 2, tr. 1½, pb. lg. £15	Flat rate with discount	3,067,624	2.203	1.06	1.44	Lg. and tr.	98
.. ..	£26,785	9,196	..	18=28 H.P.	..	10,034	..	Lg. 3½, pr. 1½	Flat rate* ..	128,007	4	2.0	2.57	* After July 1st, 1905	99
nd v. bit.	£173,560	86,583	78 arc, 1,434 inc. (8 c.p.)	28=100 H.P.	..	92,000	16	Lg. 5, or 7 & 2, pr. 2½ & 2	Flat rate & max. demand	1,194,651	4.9	1.65	2.24	Pb. lg. £21½ and £1.86	100
t. Helens	£148,924	68,019	96 arc ..	40=78 H.P.	..	71,878	10.7	Lg. 6, pr. 2½, pb. lg. £22 p.a.	Flat rate (part max dem.)	947,671	5.06	1.53	2.02	.. ..	101

98	DUNDEE	Corporation	1893	H. Richardson	200 &	600	Direct	8 Lanc., cond., feed htrs., econ., 2 B. & W., stokers	11 Willans	1 Dick Kerr, 6 Siemens, 3 Parker, 1 Int. E. E. Co.	3,010	2,120
99	DURHAM	County of Durham E.P.D. Co.	1902	A. S. Esslemont (man.)	240 & 4	80*	Direct	2 B. & W., 1 Woodeson (Clarke, Chapman) suphtrs.	3 Brush	3 Brush	400	172
100	EALING	Corporation	1894	J. Douglas Knight	102 &	204	40~, 1-ph.	6 Lanc., 4 stokers, cond., 1 Stirling	7 Browett-Lindley, 3 Belliss, 1 Davey-Paxman	Siemens, 8 A.C., 3 arc (1,800 v. D.C.)	1,000	1,003
101	EASTBOURNE	Corporation	1882	J. K. Brydges	200		50~, 1-ph.	2 Stirling, 2 Hornsby, 1 Economic, 1 B. & W.	2 Ferranti, 2 Willans, 1 Peache	2 Ferranti, 3 E.C.C.	1,200	875
102	EAST HAM	Corporation	1901	W. C. Ullmann	240 &	480	Direct	8 B. & W., cond., clg. tr., 2 Boby heaters	5 Musgrave	5 Dick Kerr	1,925	1,070
103	ECCLES	Corporation	1898	H. W. Angus	200		50~, 1-ph.	2 Lanc.	3 Browett-Lindley	2 J. & P., 1 Rosling	280	135
104	EDINBURCH	Corporation	1895	F. A. Newington	230		50~, 1-ph. & direct	36 marine, 4 water tube, with stokers	28 Willans, 5 Belliss	18 Siemens, 10 Mather & Platt, 4 Ferranti, 2 E.C.C., 1 Dick Kerr	12,037	8,431
105	ELLAND	Urban District Council	1903	A. V. Wardrop	240 &	480	Direct	1 B. & W., 1 Lanc., Meldrum 2-cell destructor	2 Belliss	2 Greenwood & Batley	280	90
106	EPSOM	Urban District Council	1902	H. F. Foster	230 &	460	Direct	2 Lanc., econ., 1 dryback, cond. and spray	2 Alley & MacLellan, 1 Belliss	2 Laurence Scott, 1 Dick Kerr	260	123
107	ERITH	Urban District Council	1903	Geo. E. Heath	3,000, & 20	350, 00	50~, 3-ph.	2 Lanc., cond.	3 Allen	3 International Elec. Eng.	350	85
108	EXETER	Corporation	1889	H. D. Munro	100	0	60~, 1 & 2 ph.	6 B. & W., suphtrs., econ., stokers	5 Belliss	4 Westinghouse A.C., 1 Westinghouse D.C., 1 Peebles motor gen.	1,500	..
109	EXMOUTH	Electric Supply Corporation	1904	J. E. Doidge	225 &	450	Direct	2 B. & W.	2 Belliss	2 Crompton	100	..
110	FALKIRK	Corporation	1903	J. McMillan	230	0	Direct	2 Dryback marine, feed heater & econ.	3 Belliss	3 Mavor & Coulson	300	157
111	FAREHAM	Urban District Council	1890	A. Blake	100	0	125~, 1-ph.	2 loco., 1 Economic	1 Ransome, 2 Browett-Lindley, 1 Peache	2 Thomson-Houston, 1 Johnson-Phillips, A.C.; 2 T. H. arc.	140	63
112	FARNWORTH	Urban District Council	1901	R. B. Leach	220 & 500 tr.	440,	Direct	3 Lanc., econ., cond.	3 Browett-Lindley, 1 Belliss	3 Lanc. D. & M. Co., 1 Westinghouse	610	397
113	FAVERSHAM	Corporation	1904	G. Sommerville	230 &	460	Direct	Dowson gas plant	2 Westinghouse, gas	2 Westinghouse	120	50
114	FELIXSTOWE & WALTON	Urban District Council (leased to Suffolk Electricity Supply Co.)	1899	Napier Prentice	200		Direct		3 Stockport, gas	1 Bruce Peebles, 1 Prentice, 1 Anglian	113	129
115	FINCHLEY	Urban District Council	1903	Edward Calvert	250 &	500	Direct	4 Hornsby "Upright"	3 Belliss	4 Sunderland Forge, 1 E.C.C.	600	260
116	FLADBURY	Fladbury Electric Light and Power	1900	Morris, Jones & Co.	220		Direct		2 British Empire turbines	1 Young	40	..
117	FLEETWOOD	Fleetwood & Dist. El. L & Pr. Synd.	1900	O. Hansom	200 &	400	Direct	2 B. & W., econ., destructor	3 Willans	2 Johnson-Phillips, 1 Laurence Scott	220	120
118	FOLKESTONE	Folkestone Electric Supply Co.	1898	T. Hesketh	210	0	Direct	4 Economic, 2 B. & W., suphtr., cond.	6 Peache, 1 Parsons turbine	6 Parker, 1 Parsons	1,200	793
119	FORT WILLIAM	Fort William Electric Lighting Co.	1896	I. Reid	150 D.C., 300 A.C.		Direct & altg.		3 Gilkes turbines and oil engine	2 Laurence Scott, 1 General Electric	120	190
120	FROME	Frome Electricity Supply Co.	1904	F. M. Nicholl	240 &	480	Direct	2 B. & W., ch. grate stokers	3 Parsons turbines	3 Parsons	375	180
121	GALWAY	Galway Electric Co.	1889	James Perry	110	0	Direct	1 Dowson gas producer plant	2 Hercules water turbines, 1 Crossley gas engine	3 Statter, 2 Crompton, 1 Holmes, geared	153	84
122	GATESHEAD	County of Durham E. P. D. Co.	1901	A. S. Esslemont	230, 4 500	30 &	Direct and altg. 50~	8 B. & W., suphtrs. and stokers	5 Brush and Belliss	7 Brown Boveri, Brush, Siemens & Halske (D.C. 2,100 KW., A.C. 750 KW.)	2,850	..
123	GILLINGHAM	Corporation	1897	A. D. Chalmers	100 &	230	50~, 3-ph.	2 B. & W.	4 Willans	4 B. T. H.	950	300
124	GLASCOW	Corporation	1892	W. W. Lackie	250 &	500	Direct	18 B. & W.	9 Willans, 4 Belliss, 1 Paul, 1 Ball & Wood, 2 Mirrlees Watson, 1 Alley & MacLellan	7 Crompton, 2 Westinghouse, 3 Peebles, 2 Walker, 2 Schuckert, 2 B. T.-H., 2 Brit. Elec. Plant	10,443	11,585
125	GLOSSOP	Urban Electric Supply Co.	1902	C. E. Knowles	240 &	480	Direct	2 Economic	3 Belliss	3 Parker	..	..
126	GLOUCESTER	Corporation	1900	W. J. Bache	220 &	440	Direct	4 Lanc., stokers, econ.	2 Belliss, 1 Willans	4 Silvertown, 2 Mather & Platt	750	304
127	GODALMING	Urban Electric Supply Co.	1902	R. S. Robertson	250		Direct	3 B. & W., chain grates, Boby feed heater	3 Belliss	3 Fowler	380	181
128	GORSEINON	Gorseinon Electric Light Co.	1894	D. Powell	200		Direct	1 Cornish (Harvey)	1 Thos. White, 1 Powis	1 Elwell Parker, 1 E. C. C.	60	35
129	GOVAN	Corporation	1900	T. C. Parsons	250 &	500	Direct	6 B. & W.	4 Belliss, 2 Browett Lindley	2 B. T. H., 1 Silvertown, 1 Dick Kerr, 2 Lanc. D. & M.	1,950	700
130	CRANTHAM	Urban Electric Supply Co.	1903	W. E. Milns	240 &	480	Direct	3 Hornsby, suphtr., Boby feed heater	3 Belliss	3 Parker	380	156
131	GRAVESEND	Corporation	1902	C. F. McInnes	250		Direct	3 B. & W., 2 Lanc., stokers, econ. and detart., Hughes & Stirling 4-cell dest.	3 Alley & MacLellan, 1 Belliss	3 Lancashire D. & M. Co., 1 Brit. Westinghouse	700	453
132	GRAYS THURROCK	Urban District Council	1901	E. D. Long	230 &	460	Direct	2 Lanc., Meldrum 2-cell destructor and Lanc. boiler	2 Reavell	2 British Schuckert	200	120
133	GREENOCK	Corporation	1899	J. A. Robertson	250 &	500	Direct	6 B. & W., stokers, econ., cond.	7 Belliss	8 Silvertown, 1 Westinghouse, 1 Westinghouse 400 KW. on order	1,600	1,165
134	GRIMSBY	Corporation	1901	W. A. Vignoles	230 &	460	Direct	4 Lanc., 1 Stirling, econ., cond., clg. tr.: Horsfall 4-cell dest.	8 Belliss	8 Mather & Platt, 2 Westinghouse	900	647
135	GUERNSEY: ST. PETER PORT	Guernsey Electricity Supply Co.	1900	A. G. Bird	210 &	420	Direct	4 B. & W., econ.	4 Belliss	4 Parker	510	368
	ST. SAMPSONS		1904	A. G. Bird	210 &	420	Direct	Anthracite gas producers	2 Campbell gas engines	2 Parker	360	500
136	GUILDFORD	Guildford Electricity Supply Co.	1896	H. L. Alderton	215 &	430	Direct	3 B. & W., 1 Hornsby vertical, Schmidt suphtr., stokers	3 Willans, 1 Howden, 1 Diesel (oil)	2 Rosling, 2 Newton, 1 E.C.C.	550	250
137	HALIFAX	Corporation	1894	W. M. Rogerson	250		Direct	6 B. & W., 2 Lanc., stokers, econ.	3 Belliss, 4 Pollit, 2 Parsons turbines	7 E. C. C., 2 Parsons	4,750	2,712
138	HAMILTON	Corporation	1903	T. M. Colson	240 &	480	Direct	4 B. & W., suphtrs., ch. grate stokers	3 Belliss	3 Parker	380	232
139	HANLEY	Corporation	1894	C. H. Yeaman	100 &	200	100~, 1-ph.	8 Lanc., cond., part suphtrs., econ.: Horsfall 8-cell destr.	4 Brush, 1 McLaren, 1 Ferranti, 1 Howden	4 Mordey, 2 Ferranti, 1 Westinghouse	1,850	795
140	HARRINGTON	Harrington Electric Light Co.	1897	W. Collins	105		Direct	3 Lanc.	2 Browett-Lindley, 1 Tangye, 1 Willans	3 Holmes, 1 Parker	210	120
141	HARROCATE	Corporation	1897	G. Wilkinson	100 &	200	50~, 1-ph.	5 Lanc., stokers, econ., suphtrs.	4 McLaren, 1 Parsons turbine, 1 Curtis	3 Ferranti, 1 Siemens, 1 Parsons, 1 Curtis	1,900	840
142	HARROW	Harrow Electric Light & Power Co.	1896	E. R. Hill	220 &	440	Direct	4 B. & W., econ., cond., suphtrs.	6 Willans	4 Crompton, 1 Mather & Platt, 1 Siemens	535	264
143	HASTINGS	Corporation	1882	R. F. Ferguson	200 &	400	100~, 1-ph.	5 B. & W., econ., cond., clg. tr.	2 Brush, 3 Belliss, 1 Parsons turbine	4 Brush, 1 Parsons, 1 G. E. Co.	1,300	667
144	HAWICK	Urban Electric Supply Co.	1902	A. N. Rye	240 &	480	Direct	3 B. & W.	4 Belliss	4 Parker	600	235
145	HEBBURN	Northern Counties Elec. Supply Co.	1903	C. S. Vesey Brown, C. W. Fairweather	230 &	460	Direct	2 B. & W.	2 Allen	2 Crompton	400	..
146	HECKMONDWIKE	Urban District Council	1901	G. H. Carter	230 &	460	Direct	2 Stirling, 1 B. & W.	2 Reavell, 2 Howden, 1 Willans	2 Fowler, 3 Dick Kerr	900	616
147	HEREFORD	Corporation	1899	W. T. Kerr	220 &	440	Direct	2 Lanc., econ., cond.	3 Belliss	3 Silvertown	450	196
148	HEYWOOD	Corporation	1900	Jas. Stott	200 &	400	Direct	2 Lanc., econ.	2 Reavell	2 Crompton	120	78
149	HICH BARNET	North Metropolitan E. P. D. Co.	1900	A. F. McCann	230 &	460	Direct	1 B. & W., 2 Tinker	2 Reavell, 2 Brush	2 Holmes, 2 Brush	300	144
150	HICH WYCOMBE	Wycombe (Borough) E. L. & P. Co.	1898	W. E. Brandreth	210 &	420	Direct	4 Paxman Economic, feed htr., 1 B. & W., fired suphtr., cond.	4 Peache, 1 Belliss	5 Parker	830	382
151	HINDHEAD AND DIST.	Hindhead & District El. Light Co.	1900	T. B. Reade	220 &	440	Direct	2 Tinker Cornish	2 Reavell, 1 Diesel (oil)	2 Lanc. D. & M. Co., 1 Siemens	50	46
152	HOLYHEAD	Urban District Council	1904	P. Williams	200 &	400	Direct	2 B. & W., 2-cell Meldrum dest.	2 Willans	2 General Electric Co.	120	98
153	HORNSEY	Corporation	1903	N. Staniland	240		Direct	3 marine	2 Browett-Lindley	2 Mather & Platt	600	310
154	HOVE	Hove Electric Lighting Co.	1892	C. B. Smith	220		Direct	2 Lanc., 7 B. & W., econ	12 Willans, 1 Belliss	15 Crompton	1,608	850
155	HOYLAKE & W. KIRBY	Urban District Council	1901	H. G. M'Haffie	230		50~, 1-ph.	3 Lanc., econ., suphtr.	4 Belliss	4 Crompton	375	198
156	HUDDERSFIELD	Corporation	1893	A. B. Mountain	100 &	200	100~, 1-ph.	11 Lanc., 6 B. & W., stokers and econ.	4 Brush, 3 McLaren, 1 Ferranti	4 Brush, 2 Ferranti, 2 Siemens	3,290	1,570
157	HULL	Corporation	1893	H. Bell	220 &	440	Direct	14 Lanc.	6 Willans, 6 Allen, 2 Browett-Lindley	2 Holmes, 12 Parker	4,454	8,520
158	ILFORD	Urban District Council	1901	A. H. Shaw	230 & 400 & 500 tr.		Direct	4 B. & W., 2 Fraser marine, suphtrs., econ.	5 Willans, 1 Belliss	3 G. E. Co., 2 Dick Kerr, 1 B. T.-H.	2,600	1,168
159	INCLETON, YORKS.	Ingleton El. Lighting & Power Co.	1900	D. Tattersall	100 & 200		Direct		2 Gilkes "Vortex" turbines	2 J. P. Hall	29	21
160	INVERNESS	North of Scotland E. L. & P. Co.	1905	E. J. Williams	240 &	480	Direct	2 B. & W., ch. grate stokers	2 Belliss	2 Parker	180	..
161	IPSWICH	Corporation	1903	F. Ayton	230 &	460	Direct	4 Danks dryback, 4-cell Meldrum dest.	7 Reavell	9 A. E. G.	1,011	Lg. 361, tr. 450
162	ISLEWORTH AND HESTON	Urban District Council	1904	F. A. Bond	240 &	480	Direct	3 B. & W., two with Hughes & Stirling 6-cell destructor	3 Peache	2 Helios, 1 Westinghouse	530	280
163	JARROW	County of Durham El. Pr. Dist. Co.	1902	A. S. Esslemont	230 &	460	Direct	3 B. & W. marine, 1 Fraser dryback	5 Universal	5 Brush	500	162
164	KEICHLEY	Corporation	1901	J. M. Smyth	230 &	460	Direct	2 Lanc., stokers, econ., cond.	3 Allen	3 Parker	440	120
165	KENDAL	Corporation	1902	W. Thomson	220 &	440	Direct	2 Dryback	2 Willans, 1 Westinghouse gas engine	2 Johnson & Phillips, 1 Westinghouse	108	66
166	KESWICK	Keswick Electric Light Co.	1890		100		75~, 1-ph.	1 Lanc.	1 Westinghouse, 1 Victor turbine	Kapp, E. C. C.	120	..
167	KETTERING	Urban District Council	1904	F. J. Bakewell	230 &	460	Direct	3 Lanc., econ. 1 Lanc. with 2-cell Meldrum dest.	4 Willans	4 Parker	480	..
168	KIDDERMINSTER	Kidderminster & Dist. E. L. & Tr. Co.	1900	G. Charlton	230 &	460	Direct	5 B. & W., econ.	3 Brush, 2 Parsons turbines	3 Mordey, 2 Parsons	1,050	395
169	KILLARNEY	Killarney Electric Lighting Co.	1893	L. C. Trevor-Roper	100		100~, 1-ph	1 loco-type, cond.	1 Fowler, 1 turbine, 1 water-wheel	2 Mordey, 1 Ferranti	160	84
170	KILMALCOLM	Kilmalcolm Electric Lighting Co.	1903	James Brown	240		Direct	1 B. & W.	1 Belliss	2 Laurence Scott	50	30
171	KILMARNOCK	Corporation	1904	A. H. Burbidge	240 & 480		Direct	3 Lanc.	4 Belliss	4 Dick Kerr	500	..
172	KING'S LYNN	Corporation	1899	J. Pilling	200 & 400		Direct	2 Lanc., econ., cond.; 2 vertical for producer plant	2 Belliss (steam), 5 Fielding & Platt (gas)	2 Laurence Scott, 5 G. E. Co.	520	301
173	KINCSTON-UPON-THAMES	Corporation	1893	J. E. Edgcome	165		77~, 1-ph.	3 Lanc., 4 B. & W., stokers, suphtrs., cond., econ.	12 Belliss	12 Siemens	860	475
174	KIRKCALDY	Corporation	1902	O. F. Francis	230		Direct	3 Stirling	6 Browett-Lindley	8 Laurence Scott	1,090	215 lg., 385 tr.
175	LANCASTER	Corporation	1893	W. A. Tester	230 & 460, 525 tr.		Direct	5 Lanc., and 2 Lancs. with 2-cell Meldrum destructor	4 Belliss	4 Westinghouse	1,000	680
176	LARNE	Larne Electric Lighting Works	1891	M. G. Smyth	100 & 200		100~, 1-ph.	2 Cornish, induced draught	2 Combe Barbour, 1 Belliss	2 Brush, 1 B.T.-H.	150	64
177	LEAMINCTON	Midland Electric Light & Power Co.	1887	F. W. E. Jones	115 & 230		Direct	3 Robey loco.	3 Robey, 1 Belliss	5 Chamberlain & Hookham, 1 E.C.C.	590	205
178	LEATHERHEAD	Leatherhead & District El. Supply Co.	1902	H. W. Petty	220 & 440		Direct	2 Paxman Economic	2 "Vauxhall-Rossiter"	2 Lanc. D. & M. Co.	80	30
179	LEEDS	Corporation	1893	H. Dickinson	100, 200 & 400		83~, 1-ph., 50~, 2-ph.	14 Lanc., 12 B. & W., stokers, econ., suphtrs. and cond.	1 Fowler, 2 Hick-Hargreaves, 13 Belliss, 2 McLaren	4 Ferranti, 11 E. C. C., 3 Fowler	11,540	5,540
180	LEEK	Urban District Council	1904	R. M. Carr	230 & 460		Direct		2 Stockport gas engines	2 Industrial Engineering Co.	120	36
181	LEICESTER	Corporation	1894	A. Colson	100 & 200		50~, 1-ph.	6 B. & W., 5 Lanc.	6 Hick Hargreaves	4 Ganz, 2 Brush	3,400	2,219
182	LEICH	Corporation	1899	Arthur T. Smith	220 & 440		Direct	2 B. & W., 1 Renshaw, water tube	2 Willans, 1 Galloway, 1 Howden	4 Mather & Platt, 1 G. E. Co.	760	244
183	LEITH	Corporation	1899	A. P. Rutherford	230 & 460		Direct	6 Lanc., econ.	7 Belliss, 2 Howden	7 Silvertown, 2 Crompton	1,600	1,027
184	LEWES	Lewes & District Electric Supply Co.	1901	A. A. Watkins	230 & 460		Direct	3 B. & W., suphtrs, cond., feed htr.	2 Brush, 1 Allen	3 Brush	210	101
185	LEYTON	Urban District Council	1896	F. H. Lewis	150 & 300		Direct	8 Paxman, econ.	6 Willans	5 Mather & Platt, 1 A. E. G.	1,572	915
186	LIMAVADY	Limavady Power and Light Works	1897	E. J. S. Ritter	110 & 220		100~, 1-ph.		Escher Wyss turbines	4 Siemens	240	35
187	LIMERICK	Corporation	1902	J. P. Gallinagh	230 & 460		Direct		3 Westinghouse gas engines	3 A. E. G.	180	..
188	LINCOLN	Corporation	1898	S. Clegg	230 & 460		Direct	5 Marine, 1 Climax, econ.	6 Willans, 1 Howden	7 Laurence Scott, 1 Bruce Peebles	1,018	413
189	LIVERPOOL	Corporation	1883	A. B. Holmes (Con.), Alfd. Clough (Res.), W. M. Horsfall	230 & 460		Direct	87 Lanc., stokers, econ.	79: Willans, and Browett-Lindley	79: Siemens, B. T.-H., and Bruce Peebles	24,470	14,093
190	LIVERPOOL DISTRICT	Liverpool District Lighting Co.	1897		230		Direct	3 Lanc., stokers, feed htr.	4 Willans, 2 Browett-Lindley	4 Parker, 1 Siemens, 1 Robinson	435	264

~ = cycles per second.

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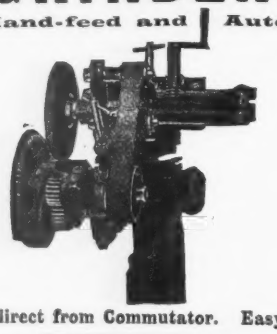

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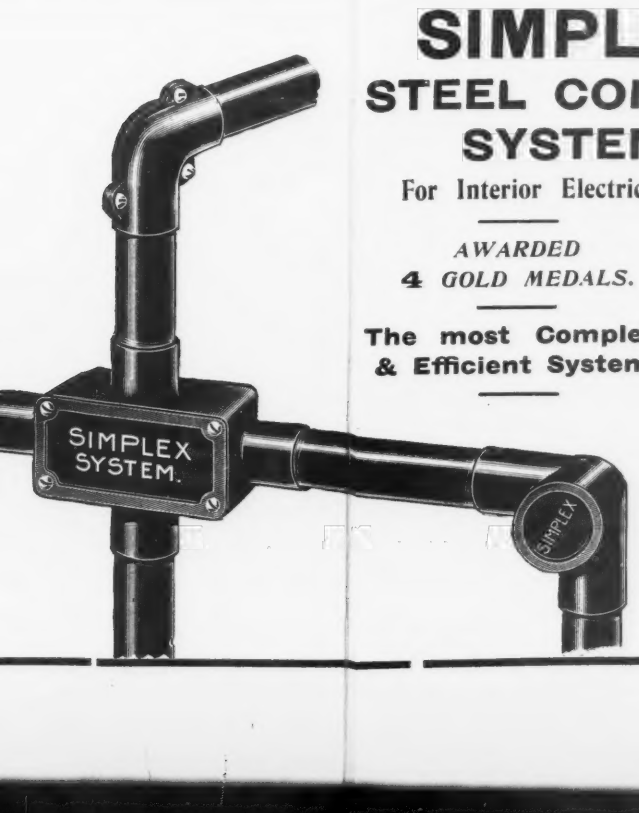
PIPE SYSTEMS FOR ELECTRIC WIRING.

1	3,010	tr. 850. 2,120	E. P. S.. max. dis. 70 KW. ..	B.I. & H. & Callender ; fdrs., single ld. covd., & v.bit. dist.,	£175,451	75,023	16 Nernst 71 arc ..	203=815 H.P.	122=3,410 H.P.	181,177	9.26	1†, tr. 2 to 1 Lg. 4 & 3, pr. 2, tr. 1½, pb. lg. £15	& flat rate Flat rate with discount	3,067,624	2.203
.	400	172	Hart, 240 amp.-hrs.	l. covd., ppr., v. bit., in Doulton con., also armd. direct Callender, solid	£26,785	9,196	..	13=28 H.P.	..	10,034	..	Lg. 3¾, pr. 1½	Flat rate* ..	128,007	4
.)	1,000	1,003	Tudor, max. dis. 94 KW. ..	Callender, Siemens and J. & P., jute (h.p.) and v. bit. (l.p.)	£172,560	86,583	73 arc, 1,424 inc. (8 c.p.)	28=100 H.P.	..	92,000	16	Lg. 5, or 7 & 2, pr. 2½ & 2	Flat rate & max. demand	1,194,651	4.9
.	1,200	875	.. ..	Glover fdrs. and dist., ppr. conc. solid ; and St. Helens twin dist.	£148,924	68,019	96 arc ..	40=78 H.P.	..	71,878	10.7	Lg. 6, 1 r. 2½, pb. lg. £22 p.a.	Flat rate (part max dem.)	947,671	5.06
.	1,925	1,070	.. ..	Callender, single lead covd., fdrs. in conduits, dist. v. bit., laid solid	£115,000	35,860	193 arc, 111 inc.	25=89 H.P.	76=1,750 H.P.	86,196	10	Lg. 6 & 2, or 4½, pr. 2½, tr. 1½"	Max. demand & flat rate	1,973,395	2.397
.	280	135	Pritchetts, 16 KW. for 9 hrs.	H.p. conc., Glover diatrine, and B.I & H. ; l.p twin, Callender, solid	£19,302	10,374	2 arc, 426 inc.	2=6 H.P. ..	..	10,980	..	Lg. 7 & 2, or 6 to 4 ..	Max. demand & flat rate	..	..
t, r	12,037	8,431	Tudor and Pritchetts, max. dis. 1,304 K.W.	.. ..	£765,612	588,502	998 arc, 13 inc.	5,514 H.P.	..	743,331	10.7	Lg. 3½, pr. 1½, pb. lg. £10½	Flat rate with discount	..	..
.	280	90	750 amp.-hrs, 400 KW.-hrs. ..	Callender, single ppr., lead covd and armd.	£14,000	5,143	2 arc, 10 inc., 2 Nernst	22=93 H.P.	..	7,468	..	Lg. 4, pr. 2	Flat rate ..	59,826	3.3
.	260	123	Pritchetts, 46 KW. for 3 hrs...	Callender and Western Electric, solid and direct ..	£32,510	7,719	12 arc, 289 inc., 30 Nernst	6=26 H.P....	..	8,591	..	Lg. 5½, pr. 2½	Flat rate ..	129,628	..
.	350	85	.. ..	Callender, lead covd., ppr., laid solid, h.p. rnd., ..	£43,000	3,500	18 arc, 644 Nernst.	2=12½ H.P....	..	6,000	..	Lg. 7 & 3, or 5, pr. 3 & 1½	Max. demand & flat rate	..	..
g-	1,500	..	.. ..	Single and twin conc., all leading makes	£90,000	36,842	33 arc ..	52=161 H.P.	24=600 H.P.	58,331	20 (ex. tr.)	Lg. 5, pb. lg. 2½, pr. 3, tr. 1½ & 1½	Flat rate ..	500,000	..
.	100	..	.. ..	.. ..	..	..	..	..	..	..	..	Lg. 6, pb. lg. 3, pr. 3	..	..	..
.	300	157	E.P.S., max. dis. 70 KW. ..	Callender, triple conc., vule. bit. lead covd.	£24,000	3,172	41 arc, 82 inc. 14 Nernst	20=58 H.P	..	12,416	..	Lg. 4½, pr. 2, pb. lg. £16½ per arc.	Flat rate with discount	159,784	..
)-	140	63	.. ..	B.I. & H. twin and conc., and Okonite	£11,490	3,050	27 arc, 109 inc.	..	..	3,760	..	Lg. 7	Flat rate ..	..	..
se	610	397	Tudor, max. dis. 160 amp. ..	B.I.&H. 5-core, lead covd. and armd. fdrs., 3-core dist., and Glover 3 single lead covd., armd. solid in Howard conduit	£36,064	7,116	133 arc, 136 inc.	389 H.P. ..	24=600 H.P.	34,345	..	Lg. 7 & 3, or 5, pr. 2½ to 1, tr. 0.5, arc £16	Max. demand, flat & scale	628,632	1.45
..	120	50	E.P.S., max. dis. 230 KW. ..	Anchor Cable, v. bit. 3 single, and 3-core arc mains, armd.	£17,085	2,000	640 8-C.P. equiv.	3=5 H.P. ..	..	2,700	..	Lg. 6 to 4½, pr. 3	Sl. scale & flat rate	52,171	3.95
e,	113	129	Chloride, max. dis. 20 KW. ..	Overhead bare copper dist. ; ppr. lead covd. fdrs. underground in bitumen	..	7,000	35 arc ..	11=13 H.P.	..	7,765	..	Lg. 8 & 6½, pb. lg. 3½, pr. 6 to 4	Flat rate & scale	80,960	..
..	600	260	Pflüger, 200 KW.	Callender, conc. & triple conc., single and twin, lead covd., armd ; direct.	£50,000	19,704	2,000 inc. ..	19=54 H.P..	..	23,000	350	Lg. 6 & 3, or 4½, pr. 2, pb. lg. £3½ p.a.	Flat rate, max. dem. & cont.	257,179	..
..	40	..	.. ..	Callender, laid solid.	..	..	..	..	..	..	..	.. ..	Contract	..	..
ott	220	120	Chloride & Hart, 600 amp.-hrs.	Triple conc. and 3-core ppr., lead covd. and armd, ..	£30,000	8,000	21 arc., 600 inc.	63 H.P. ..	..	11,000	..	Lg. 6 to 3, pb. lg. 4, pr. 3 to 2	Sl. scale & flat rate	..	..
	1,200	793	Tudor, max. dis. 2 KW. ..	Callender, fdrs. triple conc. ; dist. 3-core..	£163,373	..	66 arc, 132 inc. 1 Nernst	..	..	64,915	18	Lg. 7, 4, & 2, or 6, pr. 7 & 1, or 3, pb. lg. £14 & £18	Max. demand & flat rate	903,428	4.5
ic	120	190	E. P. S. max. dis. 30 KW. ..	Overhead, and underground, Glover diatrine armd. ..	£11,091	6,000	6 arc. 60 inc.	2=4 H.P. ..	..	6,300	..	Lg. 6½, pr. 1, pb. lg. contract	Flat rate ..	..	..
..	375	180	D. P., 100 KW.	Callender, lead covd. & armd., fdrs. triple conc., dist., 3 & 4 core.	£32,000	6,283	1128 8-C.P. equiv.	98=386 H.P.	..	18,122	..	Lg. 7 & 3, or 6, pr. 4 & 1, or 2½, pb. lg. 2½	Max. demand & flat rate	..	..
es,	153	84	Tudor, 24 KW. for 3 hrs. ..	Bare copper and diatrine single in bitumen	£10,000	3,654	8 arc, 4 inc. .	8=8.5 H.P.	..	4,000	..	Lg. 5, pr. 3 .. .	Flat rate ..	68,641	4½
& w.)	2,850	..	Pollak, traction ; Hart, lighting	Callender, fdrs. triple conc. ; dist. 3-core, solid in wood troughs	..	..	..	..	..	..	..	Lg. 7 & 2½, pr. 4 & 1½ ..	Max. demand & 2-rate meter	..	..
..	950	300	.. ..	Henley, fdrs. 3-core, dist. 4-core	£70,000	12,551	1 arc, 2 inc., 266 Nernst.	7=16 H.P. ..	..	14,169	67	Lg. 7 & 2, or 4, pb. lg. 2½	Max. dem. flat pr. 2 to 1½	250,437	3.88
3 rt,	10,443	11,585	Tudor, max. dis. 840 KW. ..	Callender and B. I. & H., fdrs. twin conc.. dist. triple conc. and conc.	£1,119,048	629,098	814 arc ..	1,453=6,501 H.P.	..	895,058	27.64	Lg. 6 & 1, pb. lg. arc £14 p.a., pr. 1½ to 1	Max. demand, flat rate & contract	15,107,665	2.51
..	..	..	D. P., 400 amp.-hrs.	Callender single, laid solid	..	..	..	..	..	..	..	Lg. 7 & 4, pr. 4 & 1½ ..	Max. demand	..	..
..	750	304	E. P. S., 1,000 amp.-hrs. ..	Callender, triple conc., solid	£59,047	20,400	54 arc, 4 Nernst	13=32 H.P....	..	22,000	..	Lg. 6 & 2, pr. 3 & 1½ ..	Max. demand	..	..
..	380	181	D. P., max. dis. 90 KW. ..	Callender, v. bit. solid, in wood trough, for public lamps 3-core lead covd. and armd.	£50,801	14,180	1353 8-C.P. equiv.	18=35 H.P.	..	16,008	36	Lg. 7 & 4, or 6, pr. 4 & 1½, htg. 2½, pb. lg. cont.	Max. demand, flat, contract	202,585	3.95
..	60	35	.. ..	Overhead 2-wire, Henley, vulcanized rubber	£1,803	1,646	104 inc. ..	..	..	1,750	14	Lg. 6 & 4, or 1 3 per c.p. p.a.	Max. demand or contract	..	..
ck	1,959	700	Tudor, max. dis. 200 KW. ..	Callender, Glover, B.I & H., single lead covd. & armd.; v. bit & lead covd., laid solid	£95,000	36,748	200 arc	1,310 H.P. ..	..	76,848	79	Lg. 6 & 1, or 4 to 3, £14½ arc, pr. 2 to ½	Max. dem. flat, cont. & scale	1,114,059	2.16
..	380	156	D. P., max. dis. 68 KW. ..	Callender 3-way solid and 3-core armd., v. bit. ..	£61,075	22,000	..	62=318 H.P	..	28,950	54	Lg. 7 & 3, pr. 4 & 1 or 2½	Max. demand & flat rate	290,275	3.06
it.	700	453	Pritchetts & Gold, 630 amp.-hrs.	Western Electric lead covd., ppr., solid	£49,709	10,000	27 arc ..	10=85 H.P.	40=1,300 H.P.	14,853	10	Lg. 7 & 2, or 5, pr. 2-rate 1, tr. 2 to 1½	Max. dem. flat, 2-rate m. & c.	72,000	2.45
..	200	120	D.P., max. dis. 60 KW. ..	Callender, triple conc. bit. armd. direct and 3-core for street ltg.	£19,680	7,887	433 inc., 248 Nernst	10=33 H.P.	..	9,415	15 lg. 48 22.5	Lg. 7 & 3, or 5, pb. lg. 3.4, pr. 2½	Max. dem. flat rate & cont	165,199	4.12
1	1,600	1,165	Tudor, normal dis., 140 KW., Chloride on order for tr.	Callender and Glover, vule. bit., solid and in C.W. casing	£96,000	31,181	55 arc, 3 Nernst	164=2,049 H.P.	66=1,650 H.P.	120,861	49	Lg. 6 & 2, or 4½, pb. lg. 2.21, pr. 2½ to 1½, tr. 1.3	Max. demand, flat & scale	1,766,000	2
..	900	647	Tudor, max. dis. 125 KW. ..	Fdrs. B.I. & H. and Anchor, conc., paper, lead covd., solid ; dist. B.I., J. & P. and Anchor, triple conc.	£80,915	32,543	80 arc, 41 inc. 1 Nernst	73=345 H.P.	Max. dem.= 247 KW.	44,123 (ex. tr.	36	Lg. 4½, pr. 2½ to 1½, & 1 sw., tr. 1½ to 1½	Flat rate, cont. scale & 2-rate	1,024,382	2.36
..	510	368	D. P., max. dis. 150 KW. ..	Callender, fdrs. triple conc., armd., and 2-core	£124,391	30,000	12 inc. ..	920 H.P. ..	..	57,000	..	Lg. 7 & 3, or 6, pr. 4 & 1½	Max. demand	784,088	2.58
..	360	500	Tudor, max. dis. 336 KW. ..	solid ; dist. 3-core armd. and solid								or 2½, htrs. 2"	& flat rate		
..	550	250	Niblett, max. dis. 45 KW. ..	Callender, v. bit. and fibre ; Henley rubber conc. armd. services, laid bare.	£45,000	18,000	1 arc, 3 Nernst	33=90 H.P.	..	20,000	18	Lg. 7, pr. 4 to 2½, pb. lg. 3	Flat rate & scale	211,374	.08
..	4,750	2,712	Chloride, 1,000 amp.-hrs. ..	B.I. & H. and Callender, paper and bit.	£212,579	87,897	69 arc, 100 inc.	186=785 H.P.	..	116,317	14.6	Lg. 4 to 3, pb. lg. 3, pr. 2 to 1, tr. 1½	Flat rate & scale	4,219,630	2.19
..	380	232	Tudor, max. dis. 150 KW. ..	Callender, v. bit., single, wood troughing, solid.. ..	..	10,539	65 arc ..	50=237 H.P.	..	18,169	80	Lg. 4, pr. 2 & 1	Max. demand & flat rate	221,057	3.0
e-	1,850	795	.. ..	Glover, v. rubber ; Callender, v. bit.; B.I. & H. ppr. ..	£87,790	53,134	70 arc, 288 inc.	75=180 H.P.	..	58,993	6.54	Lg. 7 & 3, pr. 3 & 1, pb. lg. £22 & £3½	Max. demand & flat rate	844,272	4.14
..	210	120	.. ..	J. & P., twin, solid	..	4,000	..	..	..	4,746	..	Lg. 3½	Flat rate	100,000	3.5
1	1,900	840	.. ..	Glover, B.I. & H. and Siemens, conc., ppr., lead covd.	£111,400	22,000	61 arc, 354 inc	40=145 H.P.	..	71,015	18.5	Lg. 6 to 2", pb. lg. 2, pr. 2 to 1½	Max. demand & flat rate	1,051,745	3.0
1	535	264	E. P. S.	Bare cpr., and Callender in ducts and solid	£59,598	22,154	..	21=66 H.P.	..	24,000	16.3	4½ inc., 8 & 1 arc, pr. 4 & 1½	Max. demand	259,853	6.25
..	1,300	667	Tudor, max. dis. 15 KW. ..	Glover, paper, diatrine	£136,819	38,904	104 arc, 106 inc.	10=32 H.P....	..	41,977	14	Lg. 6, or 108, p.a. per lp. & 1½ p.a.*	Flat rate & Hopkinson	907,595	4.64
..	600	235	D. P., max. dis. 50 KW. ..	Callender, vule. bit. single, laid solid in wood trough, also armoured 2, 3 and 4 core for street lighting	£54,377	12,733	14 arc, 410 inc.	60=265 H.P.	..	21,683	32	Lg. 5 to 3, pr. 2½ to 1½ ..	Max. demand & flat rate	311,342	2.6
..	400	..	Chloride, 500 amp.-hrs. ..	Callender, single, laid solid	..	..	10 arc, 150 inc.	..	..	.	..	Lg. 4 to 4½, pr. 2 to 1½ ..	Flat rate & sliding scale	..	..
..	900	616*	Tudor, max. dis. 100 KW.; Chloride, max. dis. 180 KW.	Henley, fdrs. triple and plain conc., laid solid ; dist. 3 single, laid solid	£33,000	10,011	10 arc, 172 inc..	59=331 H.P.	275 KW. ..	20,467 (ex. tr.)	75	Lg. 4, pr. 1 & 2, tr. 2, pb. lg. £12½, £3 and £1½	Flat rate with discounts	419,685	2.01
..	450	196	Chloride, max. dis. 50 KW. ..	Silvertown, v. r. in bit., solid, single	£25,299	13,024	..	26=50 H.P....	..	14,524	..	Lg. 6 & 4, pr. 3 & 2 ..	Max. demand	144,802	..
..	120	78	Tudor, max. dis. 100 KW.	St. Helens and Glover, lead covd. paper, and v.-bit., single, solid in wooden troughing	£15,000	4,382	5 arc.. ..	26=108½ H.P.	..	6,922	9.5	Lg. 6 & 3, or 4½, pr. 2½ & 1½	Hopkinson & flat rate	69,811	3.9
..	300	144	Hart, max. dis. 38 KW. ..	Callender, fdrs. triple conc., armd. ; dist. 3-core, armd. laid direct	..	6,163	14 arc. 129 Nernst	1,652	..	8,279	9.5	Lg. 7 & 2 and 8 & 2, pr. 4½ & 1½	Max. demand & sl. scale	140,883	4.28
..	830	382	Tudor, max. dis. 156 KW. ..	Callender, fdrs. triple conc., dist. 3-core, all armd. direct	£94,000	24,935	12 arc, 300 Nernst	450 H.P. ..	..	37,383	17	Lg. 5 & 2, pb. lg. £13 & £3, pr. 4 & 1	Max. demand	743,177	3.27
	50	46	Tudor, 26 KW.	B. I. & H. Cables, 3-core	£12,000	3,000 (abt.)	..	5=5 H.P. ..	..	3,100	20	Lg. 8, pr. 4	Flat rate	..	..
	120	98	N. S. Electric Storage Co., 160 KW.	B. I. and H., 3-core lead covd. and armd.. laid direct..	£17,000	2,398	10 arc, 240 inc.	1=2 H.P. ..	..	3,600	..	Lg. 5, pb. lg. 3, pr. 3 ..	Flat rate	58,418	4
	600	310	E. P. S., max. dis. 250 KW. ..	Siemens, triple conc., ppr., lead covd. armd. & laid solid	£73,335	26,059	50 arc. ..	8=7 H.P. ..	..	26,280	.	Lg. 7 & 2, or 5, pr. 2½, pb. lg. 4	Max. demand & flat rate	341,240	..
.	1,608	850	Tudor, max. dis. 40 KW. .	Bare copper in culverts, insd. cable in c. iron pipes ..	£152,732	79,488	..	50=140 H.P.	..	82,867	6.7	Lg. 5½, or 7 & 4, pr. 3 & 2	Flat rate & max. demand	820,781	5.58
	375	198	Chloride, 300 amp.-hrs. ..	Callender, fibre, conc. lead covd., solid	£43,000	22,264	688 equiv. 8-C.P.	5=5¼ H.P. ..	..	24,336	..	Lg. 7 & 3, or 5½, pr. 3 & 1½, pb. lg. 3½	Max. demand & flat rate	225,201	4.5
	3,290	1,570	.. ..	B.I. & H. and Glover ; fdrs. conc armd., dist. in troughs	£175,973	124,806	38 arc, 48 inc. 4 Nernst.	139=429 H.P.	..	140,161	5	Lg. 4, pr. 2 & 1, pb. lg. £17½ & 33s p.a.	Flat rate & scale	1,787,874	3.85
	4,454	3,520	Pritchetts, 438 KW.-hrs. ..	Siemens, Callender, fdrs., conc., jute sheathed ; dist. v. bit., lead covd. and armd., and Crompton	£302,933	173,546	20 arc, 42 Nernst	419=2670 H.P.	..	240,512	10.96	Lg. 5 & 2, or 4½, pr. 2 to 1"	Max. demand fl. r. & scale	3,212,812	2.89
	2,600	1,168	E. P. S., max. dis. 200 KW. ..	Henley, conc. paper, lead covd., armd.	£135,000	50,500	60 arc. 1,400 inc., 12 Nernst	47=301 H.P.	44=1,100 H.P.	90,852	.	Lg. 6 & 2, or 4½, pr. 3 to 1, tr 1½"	Max. demand & flat rate	1,386,833	..
	29	21	D. P., 15 KW. for 9 hrs. ..	Callender, fdrs. triple conc., dist. 3-core., armd., direct	£6,000	1,900	36 inc. ..	4=15 H.P. ..	..	2,444	6	Lg. 6, pr. 3, htg. 1, pb. lg. 2.9	Flat rate and contract	17,580	4.78
	180	..	E. P. S., 400 amp.-hrs. ..	Henley, paper lead covd. and armd., fdrs. triple conc., dist. 3-core	..	..	..	..	..	..	.	Lg. 7 & 3, or 6, pr. 4 & 1½, or 2½	Max. demand & flat rate	..	..
	1,011	Lg. 361, tr. 450	Tudor, 400 amp.-hrs... ..	Johnson & Phillips, ppr., lead covd., solid in wood ..	£79,824	29,150	..	102=291 H.P.	72=1,800 H.P.	88,280	75	Lg. 6 to 4, pr. 2 to 1½, tr. 1½	Flat rate with rebates	1,066,285	1.976
	530	280	Tudor, max. dis. 260 KW. ..	Henley	..	..	..	..	..	..	..	.. ..	..	..	..
	500	162	E. P. S., max. dis. 110 KW. ..	Fdrs. triple conc., dist. 3-core, solid, Callender	£26,145	4,252	..	32=272 H.P.	..	11,052	97	Lg. 5½, pr. 1½	Flat rate	129,093	2.94
	440	120	Tudor, 35 KW. for 10 hrs. ..	Callender, jute, lead covd., & vule. bit., single, solid ..	£50,000	8,000	14 arc. 24 inc., 44 Nernst	54=200 H.P.	16=592 ..	14,120	.	Lg. 7 & 3, or 5, pr. 2½ to 1½, pb. lg. 2½, tr. 2	Max. demand & flat rate	184,807	3.61
	108	66	Tudor, max. dis. 90 amp. for ½ hr.	B.I. & H., triple conc., 2 and 3-core	£12,751	4,708	..	..	..	4,787	47.1	Lg. 6, pr. 3	Flat rate	49,495	6.04*
	120	..	.. ..	V. r. underground and overhead	..	..	..	..	..	..	..	Lg. 6	Flat rate	..	..
	480	..	E. P. S., 360 amp.-hrs. ..	Glover, ppr. ins., lead covd., conc.	£27,550	6,479	30 arc, 61 inc., 1 Nernst	37=128 H.P.	..	11,129	..	Lg. 4½, arc £17, pr. 2 to 1½	Flat rate ..	118,928	3.269
	1,050	395	Pollak, 750 amp.-hrs... ..	B.I. & H., armd., lead covd., conc. ; sep. power cables, 3-core lead covd., solid	..	11,892	..	387 H.P. ..	680 H.P. ..	46,036	9	Lg. 7 & 2½, pr. 4½ & 1½ ..	Max. demand with dis.	511,427	..
	160	84	.. ..	Callender, fdrs. armd. conc., dist. lead covd. conc. ..	..	3,200	3 inc. ..	..	..	..	..	Lg. 5	Contract & flat rate	..	..
	50	30	Tudor, max. dis. 20 KW. ..	Callender, single v. bit. ; laid solid	£15,000	..	3 Nernst ..	2=3 H.P. ..	..	5,878	50	Lg. 6, pb. lg. 4, pr. 4 ..	Flat rate	16,917	5.9
	500	..	Tudor	Callender, solid	..	..	..	..	..	..	..	Lg. 5 to 3, pr. 2½ to 1½, tr. 1½	Sl. scale and flat rate	..	..
	520	301	Chloride, max. dis. 157 KW...	Siemens, Callender, B.I. & H., triple conc.	£46,466	15,716	10 arc, 457 inc., 33 Nernst	44=189 H.P.	..	22,894	8.4	Lg. 5, 4½, 4½, pb. lg. 2.15	Flat rate & max. demand	446,112	2.88
	860	475	.. ..	Siemens, Glover, Henley, B.I. & H., armd. conc. laid direct	£92,205	31,841	75 arc, 124 inc., 9 Nernst	27=70.5 H.P.	..	35,087	18	Lg. 7 & 3, pr. 3 to 2, pb. lg. 3	Max. demand	527,133	4.7
	1,090	215 lg., 385 tr.	Tudor, max. dis. 184 KW. ..	Henley single, ppr., lead covd., solid in wood	£57,094	12,016	104 arc, 208 inc.	250 H.P.	44=1232 H.P.	52,128	..	Lg. 4½, pr. 2½, pb. lg. £12 arc p.a., tr. 1½	Sliding scale	830,186	1.99
	1,000	680	.. ..	Callender, v. bit., 3-wire	£61,386	30,773	40 arc, 80 inc.	71=268 H.P.	20=500 H.P.	49,656	8.5	Lg. 5, pr. 2½, pb. lg. 1.44, tr. 2	Flat rate & scale	637,894	3.06
	150	64	.. ..	B.I. & H. fdrs. conc., paper ; dist. bare copper, overhead	..	2,000	3 Nernst, 125 inc.	..	..	..	..	Lg. from 1½, pb. lg. £2.6 p. 16 c.p. p.a.	Contract & meters	..	..
	590	205	E.P.S., max. dis. 290 KW., Har in substn. max. dis. 240 KW	Callender, jute, lead covd., fdrs. armd., dist. bit. solid..	..	16,679	1 arc.. ..	21=50 H.P.	..	17,929	4	Lg. 7 & 2½, or 6, pr. 4 to 2½	M. d., flat rate, & time switch*	169,313	..
	80	30	Tudor, 86 KW. for 3 hrs. .	Glover, lead covd. 3-core laid solid in Howard troughing	£18,465	6,241	..	2=7 H.P. ..	..	6,393	33	Lg. 7 & 4*, pr. 4	Flat rate & sl. scale	43,118	5.9
	11,540	5,540	.. ..	B.I. & H., Henley, &c., ppr. insd.	£822,123 (abt.)	260,670	247 arc ..	836=3,905 H.P.	..	362,248	17.7	Lg. 4 & 1, pb. lg. 1½, pr. 2 to 1½	Special scale* & max. dem.	..	..
	120	36	A. B. P. Accumulators, max dis. 57 KW.	Callender, fdrs., conc. and tri. conc., paper, bitite sh. ; dis., tri. conc., paper, and 3 single v. bit., solid	£11,861	2,555	..	9=18 H.P....	..	3,069	..	Lg. 7 & 3, or 6, pr. 2½ to 1½	Max. dem., flat rate & sl. scale	14,207	4.51
	3,400	2,219	.. ..	B.I. & H., paper conc.	£245,131	152,152	..	188=704 H.P.	..	186,316	17	Lg. 4, pr. 2	Flat rate ..	1,940,014	3.79
	760	244	Chloride, max. dis. 140 KW..	B.I. & H., Johnson & Phillips, and Anchor Cable Co., triple conc., lead covd., solid	..	14,115	..	123=829 H.P.	..	..	..	Lg. 7 & 2½, or 5, pr. 3 & ½	Max. demand & flat rate	475,000	2.25
	1,600	1,027	E. P. S., max. dis. 300 KW. .	B.I. & H., triple conc., ppr., direct with steel plates, and solid in wood	£125,000	51,323	288 arc ..	234=1,788 H.P.	..	105,799	27.96	Lg. 3¾, pb. lg. £18, pr. 1½	Flat rate with discount	..	..
	210	101	Hart, max. dis. 14 KW. .	Western Electric, paper, fdrs. triple conc., dist. 3-core	£25,044	6,245	..	5=18½ H.P.	..	6,930	17	Lg. 7 & 2½, or 6, pr. 4½ & 1½, or 2½	Max. demand & flat rate	85,130	4.58
	1,572	915	Tudor, max. dis. 250 KW. .	Armd. conc., also lead covd. in ducts for dist.	£147,000	52,425	1080 arc, 3,305 inc.	28=119 H.P.	..	59,953	16	Lg. 5 & 2, pr. 3 & 1 or 2"	Max. demand & flat rate	1,357,254	3.875
	240	35	.. ..	Bare copper, overhead	..	1,000	..	..	..	..	..	10s. per 8-C.P.	Contract ..	..	..
	180	..	.. ..	Fdrs. conc., dist. single, laid solid..	..	..	..	..	..	..	..	Lg. 5, pr. 2	Flat rate ..	..	..
	1,018	413	Chloride, 300 amp.-hrs. .	Callender, fdrs. conc., armd., dist. conc. and triple conc., v. bit., armd.	£35,550	29,849	34 arc, 60 inc., 34 Nernst	67=122 H.P.	..	33,606	18.4	Lg. 6 & 2½, pr. 4 & 1, or 2½"	Max. dem. w. dis. & flat r.	431,478	3.7
e	24,470	14,093	E. P. S.	Callender solid, ...	£1,718,712	476,584	189 arc 28 inc.	1,369= 5,193 H.P.		583,430 (ex. tr.)	11	Lg. 3¾ & 3, pr. 2 & 1, pb. lg. 2, tr. 1.07†	Sliding scale & flat rate	29,333,623	1.879
	435	264	E. P. S., max. dis. 116 KW. .	Callender, drs. 3 wire, dist. 2 wire, solid	£49,093	32,808	16 inc., 160 Nernst.	3=2½ H.P....	..	33,034	..	Lg. 5, or 9 & 1½, pr. 2½, pb. lg. 5, less 35½%	Flat rate and max. dem.	246,943	4.72



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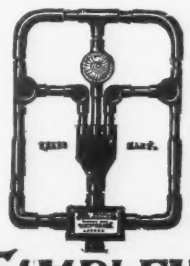

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Richardson ..	200 & 400	100	Direct ..	8 Lanc., cond., feed htrs., econ., 2 B. & W., stokers	11 Willans	1 Dick Kerr, 6 Siemens, 3 Parker, 1 Int. E. E. Co.	3,010	tr. 850. 2,120	E. P. S.. max. dis. 70 KW. ..	B.I. & H. & Callender ; fdrs., single ld. covd., & v.bit. dist., l. covd., ppr., v. bit., in Doulton con., also armd. direct
Esslemont (man.)	240 & 480	80	Direct ..	2 B. & W., 1 Woodeson (Clarke, Chapman) suphtrs.	3 Brush	3 Brush	400	172	Hart, 240 amp.-hrs.	Callender, solid .. ..
Glas Knight	102 & 204		40—, 1-ph.	6 Lanc., 4 stokers, cond., 1 Stirling	7 Browett-Lindley, 3 Belliss, 1 Davey-Paxman	Siemens, 8 A.C., 3 arc (1,800 v. D. C.)	1,000	1,003	Tudor, max. dis. 94 KW. ..	Callender, Siemens and J. & P., jute (h.p.) and v. bit. (l.p.)
Brydges ..	200		50—, 1-ph.	2 Stirling, 2 Hornsby, 1 Economic, 1 B. & W. ..	2 Ferranti, 2 Willans, 1 Peache ..	2 Ferranti, 3 E.C.C.	1,200	875	.. ..	Glover fdrs. and dist., ppr. conc. solid ; and St. Helens twin dist.
Chisum	240 & 480	80	Direct ..	8 B. & W., cond., clg. tr., 2 Boby heaters.. ..	5 Musgrave	5 Dick Kerr	1,925	1,070	.. ..	Callender, single lead covd., fdrs. in conduits, dist. v. bit., laid solid
Annis ..	200		50—, 1-ph.	2 Lanc.	3 Browett-Lindley	2 J. & P., 1 Rosling	280	135	Pritchetts, 16 KW. for 9 hrs.	H.p. conc., Glover diatrine, and B.I & H. ; l.p twin, Callender, solid
Newington	230		50—, 1-ph. & direct	36 marine, 4 water tube, with stokers	28 Willans, 5 Belliss	18 Siemens, 10 Mather & Platt, 4 Ferranti, 2 E.C.C., 1 Dick Kerr	12,037	8,431	Tudor and Pritchetts, max. dis. 1,304 K.W.	.. ..
Aldridge	240 & 480	180	Direct ..	1 B. & W., 1 Lanc., Meldrum 2-cell destructor ..	2 Belliss..	2 Greenwood & Batley	280	90	750 amp.-hrs, 400 KW.-hrs. ..	Callender, single ppr., lead covd and armd. .. ..
[illegible]	230 & 460	160	Direct ..	2 Lanc., econ., 1 dryback, cond. and spray ..	2 Alley & MacLellan, 1 Belliss ..	2 Laurence Scott, 1 Dick Kerr ..	260	123	Pritchetts, 46 KW. for 3 hrs...	Callender and Western Electric, solid and direct ..
[illegible] Heath	3400, 1700 & 2000	350, 200	50—, 3-ph.	2 Lanc., cond.	3 Allen	3 International Elec. Eng.	350	85	.. ..	Callender, lead covd., ppr., laid solid, h.p. rnd., ..
Ainsley	100		60—, 1 & 2 ph.	6 B. & W., suphtrs., econ., stokers..	5 Belliss..	4 Westinghouse A.C., 1 Westinghouse D.C., 1 Peebles motor gen.	1,500	..	.. ..	Single and twin conc., all leading makes .. ..
Bradley	225 & 450	150	Direct ..	2 B. & W.	2 Belliss	2 Crompton	100	..	.. ..	.. ..
Milton	200		Direct ..	2 Dryback marine, feed heater & econ.	3 Belliss..	3 Mavor & Coulson	300	157	E.P.S., max. dis. 70 KW. ..	Callender, triple conc., vulc. bit. lead covd. .. ..
[illegible]	100		125—, 1-ph.	2 loco., 1 Economic	1 Ransome, 2 Browett-Lindley, 1 Peache	2 Thomson-Houston, 1 Johnson-Phillips, A.C. ; 2 T. H. arc.	140	63	.. ..	B.I. & H. twin and conc., and Okonite .. ..
[illegible]	220 & 440, 580	340, 240	Direct ..	3 Lanc., econ., cond.	3 Browett-Lindley, 1 Belliss.. ..	3 Lanc. D. & M. Co., 1 Westinghouse	610	397	Tudor, max. dis. 160 amp. ..	B.I.&H. 5-core, lead covd. and armd. fdrs., 3-core dist., and Glover 3 single lead covd., armd. solid in Howard conduit
[illegible]	230 & 460	160	Direct ..	Dowson gas plant	2 Westinghouse, gas	2 Westinghouse	120	50	E.P.S., max. dis. 230 KW. ..	Anchor Cable, v. bit. 3 single, and 3-core arc mains, armd.
[illegible]	200		Direct ..	.. ..	3 Stockport. gas	1 Bruce Peebles, 1 Prentice, 1 Anglian	113	129	Chloride, max. dis. 20 KW. ..	Overhead bare copper dist. ; ppr. lead covd. fdrs. underground in bitumen
[illegible]	240 & 480	160	Direct ..	4 Hornsby "Upright"	3 Belliss..	4 Sunderland Forge, 1 E.C.C. ..	600	260	Pflüger, 200 KW.	Callender, conc. & triple conc., single and twin, lead covd., armd ; direct.
[illegible]	225		Direct ..	.. ..	2 British Empire turbines	1 Young	40	..	.. ..	Callender, laid solid. .. ..
[illegible]	240 & 480	160	Direct ..	2 B. & W., econ., destructor	3 Willans	2 Johnson-Phillips, 1 Laurence Scott	220	120	Chloride & Hart, 600 amp.-hrs.	Triple conc. and 3-core ppr., lead covd. and armd, ..
[illegible]	240		Direct ..	4 Economic, 2 B. & W., suphtr., cond.	6 Peache, 1 Parsons turbine.. ..	6 Parker, 1 Parsons	1,200	793	Tudor, max. dis. 2 KW. ..	Callender, fdrs. triple conc. ; dist. 3-core.. .. .. ..
[illegible]	150 & 300, 300 & 600	100 & 200	Direct and alts.	.. ..	3 Gilkes turbines and oil engine ..	2 Laurence Scott, 1 General Electric	120	190	E. P. S. max. dis. 30 KW. ..	Overhead, and underground, Glover diatrine armd. ..
[illegible]	240 & 480	180	Direct ..	2 B. & W., ch. grate stokers	3 Parsons turbines	3 Parsons	375	180	D. P., 100 KW.	Callender, lead covd. & armd., fdrs. triple conc., dist., 3 & 4 core.
[illegible]	11		Direct ..	1 Dowson gas producer plant	2 Hercules water turbines, 1 Crossley gas engine	3 Statter, 2 Crompton, 1 Holmes, geared	153	84	Tudor, 24 KW. for 3 hrs. ..	Bare copper and diatrine single in bitumen .. ..
[illegible]	230, 110 & 240	Direct and alts. 240—	8 B. & W., suphtrs. and stokers	5 Brush and Belliss	7 Brown Boveri, Brush, Siemens & Halske (D.C. 2,100 KW., A.C. 750 KW.)	2,850	..	Pollak, traction ; Hart, lighting	Callender, fdrs. triple conc. ; dist. 3-core, solid in wood troughs
[illegible]	100 & 200	50—, 3-ph.	2 B. & W.	4 Willans	4 B. T. H.	950	300	.. ..	Henley, fdrs. 3-core, dist. 4-core .. ..
[illegible]	250 & 500	300	Direct ..	18 B. & W.	9 Willans, 4 Belliss, 1 Paul, 1 Ball & Wood, 2 Mirrless Watson, 1 Alley & MacLellan	7 Crompton, 2 Westinghouse, 3 Peebles, 2 Walker, 2 Schuckert, 2 B. T.-H., 2 Brit. Elec. Plant	10,443	11,585	Tudor, max. dis. 840 KW. ..	Callender and B. I. & H., fdrs. twin conc., dist. triple conc. and conc.
[illegible]	240 & 480	180	Direct ..	2 Economic	3 Belliss	3 Parker	..	..	D. P., 400 amp.-hrs.	Callender single, laid solid .. ..
[illegible]	220 & 440	160	Direct ..	4 Lanc., stokers, econ.	2 Belliss, 1 Willans	4 Silvertown, 2 Mather & Platt ..	750	304	E. P. S., 1,000 amp.-hrs. ..	Callender, triple conc., solid .. ..
[illegible]	240		Direct ..	3 B. & W., chain grates, Boby feed heater ..	3 Belliss	3 Fowler..	380	181	D. P., max. dis. 90 KW. ..	Callender, v. bit. solid, in wood trough, for public lamps 3-core lead covd. and armd.
[illegible]	2[illegible]		Direct ..	1 Cornish Horsey	1 Thos. White, 1 Powis	1 Elwell Parker, 1 E. C. C.	60	35	.. ..	Overhead 2-wire, Henley, vulcanized rubber .. ..
[illegible]	250 & 500	300	Direct ..	6 B. & W.	4 Belliss, 2 Browett Lindley.. ..	2 B. T. H., 1 Silvertown, 1 Dick Kerr, 2 Lanc. D. & M.	1,950	700	Tudor, max. dis. 200 KW. ..	Callender, Glover, B.I & H., single lead covd. & armd.; v. bit & lead covd., laid solid
[illegible]	240 & 480	180	Direct ..	3 Hornsby, suphtrs. Boby feed heater	3 Belliss	3 Parker	380	156	D. P., max. dis. 68 KW. ..	Callender 3-way solid and 3-core armd., v. bit. ..
[illegible]	2[illegible]		Direct ..	3 B. & W., 2 Lanc., stokers, econ. and detart., Hughes & Stirling 4-cell dest.	3 Alley & MacLellan, 1 Belliss ..	3 Lancashire D. & M. Co., 1 Brit. Westinghouse	700	453	Pritchetts & Gold, 630 amp.-hrs.	Western Electric lead covd., ppr., solid .. .. ..
[illegible]	230 & 460	160	Direct ..	2 Lanc., Meldrum 2-cell destructor and Lanc. boiler	2 Reavell	2 British Schuckert	200	120	D.P., max. dis. 60 KW. ..	Callender, triple conc. bit. armd. direct, and 3-core for street ltg.
[illegible]	250 & 500	300	Direct ..	6 B. & W., stokers, econ., cond.	7 Belliss	8 Silvertown, 1 Westinghouse, 1 Westinghouse 400 KW. on order	1,600	1,165	Tudor, normal dis., 140 KW., Chloride on order for tr.	Callender and Glover, vulc. bit., solid and in C.W. casing
[illegible]	240 & 480	160	Direct ..	4 Lanc., 1 Stirling, econ., cond., clg. tr.; Horsfall 4-cell dest.	8 Belliss	8 Mather & Platt, 2 Westinghouse..	900	647	Tudor, max. dis. 125 KW. ..	Fdrs. B.I. & H. and Anchor, conc., paper, lead covd., solid ; dist. B.I., J. & P. and Anchor, triple conc.
[illegible]	210 & 420	280	Direct ..	4 B. & W., econ.	4 Belliss	4 Parker	510	368	D. P., max. dis. 150 KW. ..	Callender, fdrs. triple conc., armd., and 2-core solid ; dist. 3-core armd. and solid
[illegible]	240 & 480	160	Direct ..	Automatic gas producers	2 Campbell gas engines	2 Parker..	360	500	Tudor, max. dis. 336 KW. ..	
[illegible]	240 & 480	160	Direct ..	3 B. & W., 1 Hornsby vertical, Schmidt suphtr., stokers	3 Willans, 1 Howden, 1 Diesel (oil)	2 Rosling, 2 Newton, 1 E.C.C. ..	550	250	Niblett, max. dis. 45 KW. ..	Callender, v. bit. and fibre : Henley rubber conc. armd. services, laid bare.
[illegible]	2[illegible]		Direct ..	6 B. & W., 2 Lanc., stokers, econ. ..	3 Belliss, 4 Follit, 2 Parsons turbines	7 E. C. C., 2 Parsons	4,750	2,712	Chloride, 1,000 amp.-hrs. ..	B.I. & H. and Callender, paper and bit. .. .. ..
[illegible]	240 & 480	180	Direct ..	4 B. & W., suphtrs., ch. grate stokers	3 Belliss	3 Parker..	380	232	Tudor, max. dis. 150 KW. ..	Callender, v. bit., single, wood troughing, solid.. ..
[illegible]	100 & 200	100—, 1-ph.	8 Lanc., cond., part suphtrs., econ.; Horsfall 8-cell dest.	4 Brush, 1 McLaren, 1 Ferranti, 1 Howden	4 Mordey, 2 Ferranti, 1 Westinghouse	1,850	795	.. ..	Glover, v. rubber ; Callender, v. bit.; B.I. & H. ppr. ..
[illegible]	10		Direct ..	3 Lanc.	2 Browett-Lindley, 1 Tangye, 1 Willans	3 Holmes, 1 Parker	210	120	.. ..	J. & P., twin, solid .. ..
[illegible]	100 & 200	50—, 1-ph.	5 Lanc., stokers, econ., suphtrs.	4 McLaren, 1 Parsons turbine, 1 Curtis	3 Ferranti, 1 Siemens, 1 Parsons, 1 Crompton	1,900	840	.. ..	Glover, B.I. & H. and Siemens, conc., ppr., lead covd.
[illegible]	230 & 460	160	Direct ..	4 B. & W., econ., cond., suphtrs.	6 Willans	4 Crompton, 1 Mather & Platt, 1 Siemens	535	264	E. P. S.	Bare cpr., and Callender in ducts and solid .. ..
[illegible]	200 & 400	100—, 1-ph.	3 B. & W., econ., cond., clg. tr.	2 Brush, 3 Belliss, 1 Parsons turbine	4 Brush, 1 Parsons, 1 G. E. Co. ..	1,300	667	Tudor, max. dis. 15 KW., ..	Glover, paper, diatrine .. ..
[illegible]	240 & 480	180	Direct ..	4 B. & W.	4 Belliss	4 Parker	600	235	D. P., max. dis. 50 KW. ..	Callender, vulc. bit. single, laid solid in wood trough, also armoured 2, 3 and 4 core for street lighting
[illegible]	200 & 400	100	Direct ..	2 B. & W.	2 Allen	2 Crompton	400	..	Chloride, 500 amp.-hrs. ..	Callender, single, laid solid .. ..
[illegible]	250 & 500	300	Direct ..	2 Stirling, 1 B. & W.	2 Reavell, 2 Howden, 1 Willans ..	2 Fowler, 3 Dick Kerr	900	616	Tudor, max. dis. 100 KW.; Chloride, max. dis. 180 KW.	Henley, fdrs. triple and plain conc., laid solid ; dist. 3 single, laid solid
[illegible]	220 & 440	160	Direct ..	2 Lanc., econ., cond.	3 Belliss..	3 Silvertown	450	196	Chloride, max. dis. 50 KW. ..	Silvertown, v. r. in bit., solid, single .. .. ..
[illegible]	200 & 400	160	Direct ..	2 Lanc., econ.	2 Reavell	2 Crompton	120	78	Tudor, max. dis. 100 KW.	St. Helens and Glover, lead covd. paper, and v.-bit., single, solid in wooden troughing
[illegible]	200 & 400	160	Direct ..	1 B. & W., 2 Tinker	2 Reavell, 2 Brush	2 Holmes, 2 Brush	300	144	Hart, max. dis. 38 KW. ..	Callender, fdrs. triple conc., armd. ; dist. 3-core, armd. laid direct
[illegible]	210 & 420	280	Direct ..	4 Paxman Economic, feed htr. ; 1 B. & W., 4-cell suphtrs. cond.	4 Peache, 1 Belliss	5 Parker	830	382	Tudor, max. dis. 156 KW. ..	Callender, fdrs. triple conc., dist. 3-core, all armd. direct
[illegible]	230 & 460	160	Direct ..	2 Tinker Cornish	2 Reavell, 1 Diesel (oil)	2 Lanc. D. & M. Co., 1 Siemens ..	50	46	Tudor, 26 KW.	B. I. & H. Cables, 3-core .. ..
[illegible]	200 & 400	160	Direct ..	2 B. & W., 2-cell Meldrum dest.	2 Willans	2 General Electric Co.	120	98	N. S. Electric Storage Co., 160 KW.	B. I. and H., 3-core lead covd. and armd., laid direct..
[illegible]	250		Direct ..	Marine	2 Browett-Lindley	2 Mather & Platt	600	310	E. P. S., max. dis. 250 KW. ..	Siemens, triple conc., ppr., lead covd. armd. & laid solid
[illegible]	250		Direct ..	2 Lanc., 7 B. & W., econ.	12 Willans, 1 Belliss	15 Crompton	1,608	850	Tudor, max. dis. 40 KW. .	Bare copper in culverts, insd. cable in c. iron pipes ..
[illegible]	2	50—, 1-ph.	3 Lanc., econ., suphtr.	4 Belliss	4 Crompton	375	198	Chloride, 300 amp.-hrs. ..	Callender, fibre, conc. lead covd., solid .. .. ..
[illegible]	100 & 200	100—, 1-ph.	11 Lanc., 6 B. & W., stokers and econ.	4 Brush, 3 McLaren, 1 Ferranti	4 Brush, 2 Ferranti, 2 Siemens ..	3,290	1,570	.. ..	B.I. & H. and Glover ; fdrs. conc. armd., dist. in troughs
[illegible]	220 & 440	160	Direct ..	14 Lanc.	6 Willans, 6 Allen, 2 Browett-Lindley	2 Holmes, 12 Parker	4,454	3,520	Pritchetts, 438 KW.-hrs. ..	Siemens, Callender, fdrs., conc., jute sheathed ; dist. v. bit., lead covd. and armd., and Crompton
[illegible]	230 & 460, 240 & 480	160	Direct ..	4 B. & W., 2 Fraser marine, suphtrs., econ.	5 Willans, 1 Belliss	3 G. E. Co., 2 Dick Kerr, 1 B. T.-H.	2,600	1,168	E. P. S., max. dis. 200 KW. ..	Henley, conc. paper, lead covd., armd. .. .. ..
[illegible]	100 & 200	100	Direct ..	.. ..	2 Gilkes "Vortex" turbines ..	2 J. P. Hall	29	21	D. P., 15 KW. for 9 hrs. ..	Callender, fdrs. triple conc., dist. 3-core., armd., direct
[illegible]	240 & 480	160	Direct ..	2 B. & W., ch. grate stokers	2 Belliss..	2 Parker..	180	..	E. P. S., 400 amp.-hrs. ..	Henley, paper lead covd. and armd., fdrs. triple conc., dist. 3-core
[illegible]	230 & 460	160	Direct ..	4 Danks dryback, 4-cell Meldrum dest.	7 Reavell	9 A. E. G.	1,011	Lg. 361, tr. 450	Tudor, 400 amp.-hrs.	Johnson & Phillips, ppr., lead covd., solid in wood ..
[illegible]	240 & 480	160	Direct ..	3 B. & W., two with Hughes & Stirling 6-cell destructor	3 Peache	2 Helios, 1 Westinghouse	530	280	Tudor, max. dis. 260 KW. ..	Henley .. ..
[illegible]	230 & 460	160	Direct ..	3 B. & W., marine, 1 Fraser dryback	5 Universal	5 Brush..	500	162	E. P. S., max. dis. 110 KW. ..	Fdrs. triple conc., dist. 3-core, solid, Callender .. ..
[illegible]	230 & 460	160	Direct ..	2 Lanc., stokers, econ., cond.	3 Allen	3 Parker..	440	120	Tudor, 35 KW. for 10 hrs. ..	Callender, jute, lead covd., & vulc. bit., single, solid ..
[illegible]	220 & 440	160	Direct ..	2 Dryback	2 Willans, 1 Westinghouse gas engine	2 Johnson & Phillips, 1 Westinghouse	108	66	Tudor, max. dis. 90 amp. for ½ hr.	B.I. & H., triple conc., 2 and 3-core .. .. ..
[illegible]	100	75—, 1-ph.	1 Lanc.	1 Westinghouse, 1 Victor turbine ..	Kapp, E. C. C..	120	..	.. ..	V. r. underground and overhead .. ..
[illegible]	230 & 460	160	Direct ..	3 Lanc., econ. 1 Lanc. with 2-cell Meldrum dest.	4 Willans	4 Parker..	480	..	E. P. S., 360 amp.-hrs. ..	Glover, ppr. ins,, lead covd., conc. .. .. ..
[illegible]	230 & 460	160	Direct ..	5 B. & W., econ.	3 Brush, 2 Parsons turbines ..	3 Mordey, 2 Parsons	1,050	395	Pollak, 750 amp.-hrs.	B.I. & H., armd., lead covd., conc. ; sep. power cables, 3-core lead covd., solid
[illegible]	10	100—, 1-ph.	1 horse-type, cond.	1 Fowler, 1 turbine, 1 water-wheel..	2 Mordey, 1 Ferranti	160	84	.. ..	Callender, fdrs. armd. conc., dist. lead covd. conc. ..
[illegible]	2[illegible]		Direct ..	1 B. & W.	1 Belliss..	2 Laurence Scott	50	30	Tudor, max. dis. 20 KW. ..	Callender, single v. bit. ; laid solid .. .. ..
[illegible]	240 & 480	180	Direct ..	3 Lanc.	4 Belliss	4 Dick Kerr	500	..	Tudor	Callender, solid .. ..
[illegible]	200 & 400	160	Direct ..	2 Lanc., econ., cond.; 2 vertical for producer plant	2 Belliss (steam), 5 Fielding & Platt (gas	2 Laurence Scott, 5 G. E. Co. ..	520	301	Chloride, max. dis. 157 KW....	Siemens, Callender, B.I. & H., triple conc. .. ..
[illegible]	10	75—, 1-ph.	3 Lanc., 4 B. & W., stokers, suphtrs., cond., econ.	12 Belliss	12 Siemens	860	475	.. ..	Siemens, Glover, Henley, B.I. & H., armd. conc. laid direct
[illegible]	250		Direct ..	3 Stirling	6 Browett-Lindley	8 Laurence Scott	1,090	215 lg., 385 tr.	Tudor, max. dis. 184 KW. ..	Henley single, ppr., lead covd., solid in wood .. ..
[illegible]	230 & 460, 525	160	Direct ..	5 Lanc., and 2 Lancs. with 2-cell Meldrum destructor	4 Belliss..	4 Westinghouse	1,000	680	.. ..	Callender, v. bit., 3-wire .. ..
[illegible]	160 & 320	100—, 1-ph.	2 Cornish, induced draught	2 Combe Barbour, 1 Belliss	2 Brush, 1 B.T.-H.	150	64	.. ..	B.I. & H. fdrs. conc., paper ; dist. bare copper, overhead
[illegible]	115 & 230	Direct	3 Robey loco.	3 Robey, 1 Belliss	5 Chamberlain & Hookham, 1 E.C.C.	590	205	E.P.S., max. dis. 230 KW., Har in substn. max. dis. 240 KW	Callender, jute, lead covd., fdrs. armd., dist. bit. solid..
[illegible]	220 & 440	Direct	2 Paxman Economic	2 "Vauxhall-Rossiter"	2 Lanc. D. & M. Co.	80	30	Tudor, 86 KW. for 3 hrs. .	Glover, lead covd. 3-core laid solid in Howard troughing
[illegible] 400	200 & 400	80—, 1-ph. 50—, 2-ph.	14 Lancs., 12 B. & W., stokers, econ., suphtrs. and cond.	1 Fowler, 2 Hick-Hargreaves, 13 Belliss, 2 McLaren	4 Ferranti, 11 E. C. C., 3 Fowler ..	11,540	5,540	.. ..	B.I. & H., Henley, &c., ppr. insd. .. ..
[illegible]	230 & 460	Direct	.. ..	2 Stockport gas engines	2 Industrial Engineering Co. ..	120	86	A. B. P. Accumulators, max dis. 57 KW.	Callender, fdrs., conc. and tri. conc., paper, bitite sh. ; dis., tri. conc., paper, and 3 single v. bit., solid
[illegible]	100 & 200	50—, 1-ph.	6 B. & W., 5 Lanc.	6 Hick Hargreaves	4 Ganz, 2 Brush	3,400	2,219	.. ..	B.I. & H., paper conc. .. ..
[illegible]	220 & 440	Direct	2 B. & W., 1 Renshaw, water tube..	2 Willans, 1 Galloway, 1 Howden ..	4 Mather & Platt, 1 G. E. Co. ..	760	244	Chloride, max. dis. 140 KW..	B.I. & H., Johnson & Phillips, and Anchor Cable Co., triple conc., lead covd., solid
[illegible]	230 & 460	Direct	6 Lanc., econ.	7 Belliss, 2 Howden	7 Silvertown, 2 Crompton	1,600	1,027	E. P. S., max. dis. 300 KW. .	B.I. & H., triple conc., ppr., direct with steel plates, and solid in wood
[illegible]	460	Direct	3 B. & W., suphtrs, cond., feed htr.	2 Brush, 1 Allen	3 Brush	210	101	Hart, max. dis. 14 KW. .	Western Electric, paper, fdrs. triple conc., dist. 3-core
[illegible]	300	Direct	8 Paxman, econ.	6 Willans	5 Mather & Platt, 1 A. E. G. ..	1,572	915	Tudor, max. dis. 250 KW. .	Armd. conc., also lead covd. in ducts for dist. .. ..
[illegible]	220	100—, 1-ph.	.. ..	Escher Wyss turbines	4 Siemens	240	35	.. ..	Bare copper, overhead .. ..
[illegible]	460	Direct	.. ..	3 Westinghouse gas engines.. ..	3 A. E. G.	180	..	.. ..	Fdrs. conc., dist. single, laid solid.. .. .. ..
[illegible]	460	Direct	5 Marine, 1 Climax, econ.	6 Willans, 1 Howden..	7 Laurence Scott, 1 Bruce Peebles..	1,018	413	Chloride, 300 amp.-hrs. .	Callender, fdrs. conc., armd., dist. conc. and triple conc., v. bit., armd.
[illegible]	460	Direct	87 Lanc., stokers, econ.	79: Willans, and Browett-Lindley..	79: Siemens, B. T.-H., and Bruce Peebles	24,470	14,093	E. P. S.	Callender solid, ...
[illegible]	30	Direct	3 Lanc., stokers, feed htr.	4 Willans, 2 Browett-Lindley ..	4 Parker, 1 Siemens, 1 Robinson ..	435	264	E. P. S., max. dis. 116 KW. .	Callender, drs. 3 wire, dist. 2 wire, solid .. ..

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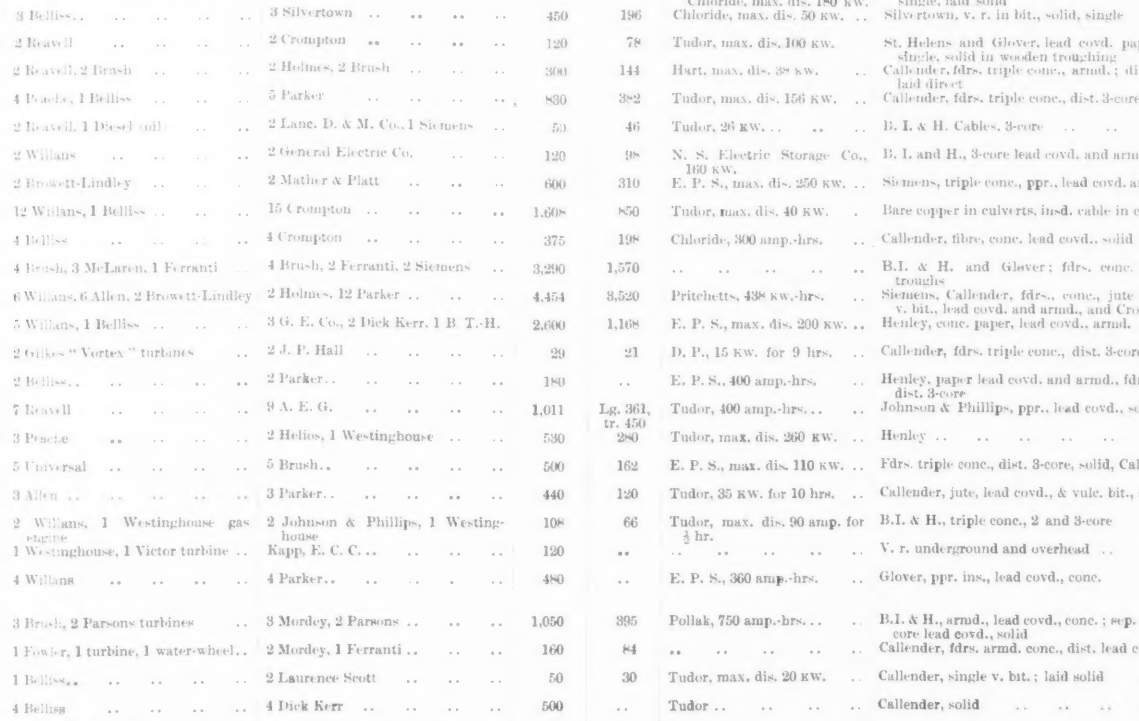

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		16 Nernst						1†, tr. 2 to 1	& flat rate							
covd., & v.bit. dist.,	£175,451	75,923	71 arc ..	203=815 H.P.	122=3,410 H.P.	181,177	9.26	Lg. 4 & 3, pr. 2, tr. 1½, pb. lg. £15	Flat rate with discount	3,067,624	2.203	1.06	1.44	Lg. and tr.	98
., also armd. direct	£26,785	9,196	..	13=28 H.P.	..	10,034	..	Lg. 3¾, pr. 1½	Flat rate* ..	128,007	4	2.0	2.57	* After July 1st, 1905	99
e (h.p.) and v. bit.	£172,560	86,583	73 arc, 1,424 inc. (8 c.p.)	28=100 H.P.	..	92,000	16	Lg. 5, or 7 & 2, pr. 2½ & 2	Flat rate & max. demand	1,194,651	4.9	1.65	2.24	Pb. lg. £21½ and £1.36	100
l; and St. Helens	£148,924	68,019	96 arc ..	40=78 H.P.	..	71,878	10.7	Lg. 6, 1 r. 2½, pb. lg. £22 p.a.	Flat rate (part max dem.)	947,671	5.06	1.58	2.02	.. ..	101
n conduits, dist.	£115,000	35,860	193 arc, 111 inc.	25=89 H.P.	70=1,750 H.P.	86,196	10	Lg. 6 & 2, or 4½, pr. 2½, tr. 1½*	Max. demand & flat rate	1,973,395	2.397	1.04	1.19	Lg. and tr. Financial data approximate only. *Pb. lg. arc £18, inc. £1 5/6	102
& H.; l.p twin,	£19,302	10,374	2 arc, 426 inc.	2=6 H.P. ..	..	10,980	..	Lg. 7 & 2, or 6 to 4 ..	Max. demand & flat rate	..	..	..	..	Traction contemplated	103
.. .. ..	£765,612	588,502	998 arc, 13 inc.	5,514 H.P.	..	743,331	10.7	Lg. 3¼, pr. 1¼, pb. lg. £10¼	Flat rate with discount	..	..	..	..	1,200 H.P. set and 2 boilers being erected	104
armd.	£14,000	5,143	2 arc, 10 inc., 2 Nernst	22=93 H.P.	..	7,468	..	Lg. 4, pr. 2	Flat rate ..	59,826	3.3	.448	1.448	.. ..	105
l and direct ..	£32,510	7,719	12 arc, 289 inc., 30 Nernst	6=26 H.P....	..	8,591	..	Lg. 5½, pr. 2¾	Flat rate ..	129,628	..	..	..	* Are £17½, Nernst £5, inc. £3¼ ..	106
h.p. rnd., ..	£43,000	3,500	18 arc, 644 Nernst.	2=12½ H.P....	..	6,000	..	Lg. 7 & 3, or 5, pr. 3 & 1½	Max. demand & flat rate	..	..	..	..	.. ..	107
kes	£90,000	36,842	33 arc ..	52=161 H.P.	24=600 H.P.	58,331	20 (ex. tr.)	Lg. 5, pb. lg. 2½, pr. 3, tr. 1⅞ & 1¾	Flat rate ..	500,000	..	..	..	Lg. and tr. Tramways started in April	108
.. .. ..	..	..	..	..	..	..	..	Lg. 6, pb. lg. 3, pr. 3 ..	.. ..	..	..	..	..	.. ..	109
covd.	£24,000	3,172	41 arc, 82 inc. 14 Nernst	20=53 H.P	..	12,416	..	Lg. 4½, pr. 2, pb. lg. £16½ per arc.	Flat rate with discount	159,784	..	..	..	.. ..	110
e	£11,490	3,050	27 arc, 109 inc.	..	..	3,760	..	Lg. 7	Flat rate ..	..	..	..	..	.. ..	111
s., 3-core dist., and in Howard conduit	£36,064	7,116	133 arc, 136 inc.	389 H.P. ..	24=600 H.P.	34,345	..	Lg. 7 & 3, or 5, pr. 2½ to 1, tr. 0.5, arc £16	Max. demand, flat & scale	628,032	1.45	.64	.84	Lg. and tr. Supply part of Kearsley.	112
3-core arc mains,	£17,085	2,000	640 8-C.P. equiv.	3=5 H.P. ..	..	2,700	..	Lg. 6 to 4½, pr. 3	Sl. scale & flat rate	52 171	3.95	..	2.45	.. ..	113
lead covd. fdrs.	..	7,000	35 arc ..	11=13 H.P.	..	7,765	..	Lg. 8 & 6½, pb. lg. 3½, pr. 6 to 4	Flat rate & scale	80,999	..	..	..	Works leased to Co. for 25 years ..	114
le and twin, lead	£50,000	19,704	2,000 inc. ..	19=54 H.P..	..	23,600	350	Lg. 6 & 3, or 4½, pr. 2, pb. lg. £3½ p.a.	Flat rate, max. dem. & cont.	257,179	..	1.81	2.42	First complete year	115
.. .. ..	..	..	..	..	..	..	..	.. ..	Contract ..	..	..	..	..	.. ..	116
t. and armd. ..	£30,000	8,000	21 arc., 600 inc.	63 H.P. ..	..	11,000	..	Lg. 6 to 3, pb. lg. 4, pr. 3 to 2	Sl. scale & flat rate	..	..	..	..	.. ..	117
ore..	£163,373	..	66 arc, 132 inc. 1 Nernst	..	..	64,915	18	Lg. 7, 4, & 2, or 6, pr. 7 & 1, or 3, pb. lg. £14 & £18	Max. demand & flat rate	903,428	4.5	1.54	2.16	2,750 v., D.C. feeders. Supply to Sandgate and Hythe	118
iatrine armd. ..	£11,091	6,000	6 arc, 60 inc.	2=4 H.P. ..	..	6,300	..	Lg. 6½, pr. 1, pb. lg. contract	Flat rate ..	..	..	..	..	.. ..	119
riple conc., dist.,	£32,000	6,283	1128 8-C.P. equiv.	98=386 H.P.	..	18,122	..	Lg. 7 & 3, or 6, pr. 4 & 1, or 2½, pb. lg. 2½	Max. demand & flat rate	..	..	..	..	Supply commenced July, 1904	120
umen	£10,000	3,654	8 arc, 4 inc...	8=8.5 H.P.	..	4,000	..	Lg. 5, pr. 3 .. .	Flat rate ..	68,641	4½	1½	3	Water power chief source of supply .	121
ore, solid in wood	..	..	..	..	..	..	..	Lg. 7 & 2½, pr. 4 & 1½ ..	Max. demand & 2-rate meter	..	..	..	..	Lg. and tr.	122
.. .. ..	£70,000	12,551	1 arc, 2 inc., 266 Nernst.	7=16 H.P. ..	..	14,169	67	Lg. 7 & 2, or 4, pb. lg. 2½ pr. 2 to 1½	Max. dem. flat r. & sl. scale	250,437	3.88	2.67	3.62	D.C. supplied in bulk to Naval Hospital (Admiralty) at 220 v.	123
conc., dist. triple	£1,119,048	629,098	814 arc ..	1,453=6,501 H.P.	..	805,058	27.64	Lg. 6 & 1, pb. lg. arc £14 p.a., pr. 1½ to ¾	Max. demand, flat rate & contract	15,107,665	2.51	.79	.99	Three stations, & bulk supply from Tramways Dept. Data to May 31, 1904	124
.. .. ..	..	..	..	..	..	..	..	Lg. 7 & 4, pr. 4 & 1½ ..	Max. demand	..	..	..	..	.. ..	125
.. .. ..	£59,047	20,400	54 arc, 4 Nernst	13=32 H.P....	..	22,000	..	Lg. 6 & 2, pr. 3 & 1½ ..	Max. demand	..	..	..	..	.. ..	126
ough, for public	£50,801	14,180	1353 8-C.P. equiv.	18=35 H.P.	..	16,008	36	Lg. 7 & 4, or 6, pr. 4 & 1½, htg. 2½, pb. lg. cont.	Max. demand, flat, contract	202,585	3.95	1.73	2.04	.. ..	127
ubber	£1,800	1,646	104 inc. ..	..	..	1,750	14	Lg. 6 & 4, or 1 3 pr c.p. p.a.	Max. demand or contract	..	..	..	..	.. ..	128
ad covd. & armd.:	£95,000	36,748	200 arc	1,310 H.P. ..	..	76,848	79	Lg. 6 & 1, or 4 to 3, £14½ arc. pr. 2 to ½	Max. dem., flat, cont. & scale	1,114,079	2.16	.707	1.062	*Costs increased due to renewals out of revenue	129
d., v. bit.	£61,075	22,000	..	62 318 H.P	..	28,950	54	Lg. 7 & 3, pr. 4 & 1 or 2½	Max. demand & flat rate	260,275	3.06	1.09	1.56	Small houses free-wired, 7d. p. u. slot meter.	130
d	£49,709	10,000	27 arc ..	10=85 H.P.	40=1,200 H.P.	14,853	10 (pr. lg. 48)	Lg. 7 & 2, or 5, pr. 2-rate 1, tr. 2 to 1½*	Max. dem., flat, 2-r.te m. & c.	729,060	2.46	1.25	1.45	Lighting and traction. *Arc £17.5 & £10, Nernst £3.7	131
ct. and 3-core for	£19,680	7,887	433 inc., 248 Nernst	10=33 H.P.	..	9,415	22.5	Lg. 7 & 3, or 5, pb. lg. 3.4, pr. 2½	Max. dem., flat rate & cont	165,199	4.12	1.74	2.41	.. ..	132
lid and in C.W.	£96,000	31,181	55 arc, 3 Nernst	164=2,049 H.P.	66=1,650 H.P.	120,861	49	Lg. 6 & 2, or 4½, pb. lg. 2.21, pr. 2½ to 1¼, tr. 1.2	Max. demand, flat r. & scale	1,766,000	2	.74	.99	Lg. and tr. Output and costs for last two months estimated.	133
aper, lead covd., r, triple conc.	£80,915	32,543	80 arc, 41 inc. 1 Nernst	73=345 H.P.	Max. dem.= 247 kw.	44.123 (ex. tr.	36	Lg. 4½, pr. 2½ to 1½, & 1 t. sw., tr. 1½ to 1¼*	Flat rate, cont., scale & t. sw.	1,024,982	2.36	.77	1.06	Lg. and tr. Energy supplied to Tramway Co. *Pb. lg. are £20 p.a.	134
rmd., and 2-core ed	£124,391	30,000	12 inc. ..	920 H.P. ..	..	57,000	..	Lg. 7 & 3, or 6, pr. 4 & 1½ or 2½, htg. 2*	Max. demand & flat rate	784,088	2.58	1.12	1.39	Data to Dec. 1904. *Pb. lg. inc. £2½ p.a.	135
bber conc. armd.	£45,000	18,000	1 arc, 3 Nernst	33=90 H.P.	..	20,000	18	Lg. 7, pr. 4 to 2½, pb. lg. 3	Flat rate & scale	211,374	.08	1.91	2.72	.. ..	136
t.	£212,579	87,897	69 arc, 100 inc.	186=785 H.P.	..	110,317	14.6	Lg. 4 to 3, pb. lg. 3, pr. 2 to 1, tr. 1½	Flat rate & scale	4,219,680	2.19	.92	1.21	Lg. and tr.	137
ing, solid	..	10,539	65 arc ..	50=237 H.P.	..	18,169	80	Lg. 4, pr. 2 & 1	Max. demand & flat rate	221,057	3.0	..	..	.. ..	138
B.I. & H. ppr. ..	£87,790	53,134	70 arc, 288 inc.	75=180 H.P.	..	58,993	6.54	Lg. 7 & 3, pr. 3 & 1, pb. lg. £22 & £3½	Max. demand & flat rate	844,272	4.14	1.72	2.38	*About to be used as auxiliary station. 2,400 yds. from electricity works	139
.. .. ..	..	4,000	..	..	..	4,746	..	Lg. 3½	Flat rate ..	100,000	3.5	1.25	2.5	.. ..	140
ppr., lead covd.	£111,400	22,000	61 arc, 354 inc	40=145 H.P.	..	71,015	18.5	Lg. 6 to 2*, pb. lg. 2, pr. 2 to 1½	Max. demand & flat rate	1,051,745	3.9	1.16	1.63	*Price 6d. and 2d. over 15,000 units ..	141
solid	£59,538	22,154	..	21=66 H.P.	..	24,090	16.3	4½ inc. 8 & 1 arcs, pr. 4 & 1½	Max. demand	259,833	6.25	1.07	2.61	.. ..	142
.. .. ..	£136,819	38,904	104 arc, 106 inc.	10=32 H.P....	..	41,977	14	Lg. 6, or 108. p.a. per lp. & 1½ p.a.*	Flat rate & Hopkinson	907,595	4.64	1.82	2.34	*Pb. lg. £15 per kw. & 1½d. per unit. pr. 3: lg. also 6 & 2½	143
in wood trough, eet lighting	£54,377	12,733	14 arc, 410 inc.	60=265 H.P.	..	21,683	32	Lg. 5 to 3, pr. 2½ to 1½ ..	Max. demand & flat rate	311,342	2.6	.88	1.2	.. ..	144
.. .. ..	..	..	10 arc, 150 inc.	..	..	.	..	Lg. 4 to 4½, pr. 2 to 1¾ ..	Flat rate & sliding scale	..	..	..	..	.. ..	145
aid solid; dist. 3	£33,000	10,011	10 arc, 172 inc.	59=331 H.P.	275 kw. ..	20,467 (ex. tr.)	75	Lg. 4, pr. 1 & 2, tr. 2, pb. lg. £12½, £3 and £1¼	Flat rate with discounts	419,685	2.01	.6	.89	Lg. and tr.* Tramway max. demand during the year, 416 kw.	146
.. .. ..	£25,209	13,024	..	26=50 H.P....	..	14,524	..	Lg. 6 & 4, pr. 3 & 2 ..	Max. demand*	144,802	..	..	..	Auxiliaries driven by electric motors. *Now flat rate	147
aper, and v.-bit.,	£15,000	4,382	5 arc.. ..	26=108½ H.P.	..	6,922	0.5	Lg. 6 & 3, or 4½, pr. 2½ & 1½	Hopkinson & flat rate	69,811	3.9	2.69	3.64	.. ..	148
ist. 3-core, armd.	..	6,163	14 arc. 129 Nernst	1,652	..	8,279	0.9	Lg. 7 & 2 and 8 & 2*, pr. 4½ & 1½	Max. demand & sl. scale	149,885	4.28	.	3.39	* With free wiring	149
re, all armd. direct	£94,000	24,935	12 arc, 300 Nernst	450 H.P. ..	..	37,383	17	Lg. 5 & 2, pb. lg. £13 & £3, pr. 4 & 1	Max. demand	543,177	3.27	..	1.63	.. ..	150
.. .. ..	£12,000	3,000 (abt.)	..	5=5 H.P. ..	..	3,100	26	Lg. 8, pr. 4	Flat rate ..	..	..	..	..	.. ..	151
nd., laid direct..	£17,000	2,398	10 arc, 240 inc.	1=2 H.P. ..	..	3,600	..	Lg. 5, pb. lg. 3, pr. 3 ..	Flat rate ..	58,318*	4	2.55	..	* Started supply Sept. 16th, 1904 ..	152
armd. & laid solid	£73,335	26,059	50 arc. ..	8=7 H.P. ..	..	26,289	..	Lg. 7 & 2, or 5, pr. 2½, pb. lg. 3	Max. demand & flat rate	341,230	..	..	..	.. ..	153
c. iron pipes ..	£152,732	79,488	..	50=140 H.P.	..	82,867	6.7	Lg. 5½, or 7 & 4, pr. 3 & 2	Flat rate & max. demand	820,781	5.58	1.75	2.39	.. ..	154
d	£43,000	22,264	688 equiv. 8-C.P.	5=5½ H.P. ..	..	24,336	..	Lg. 7 & 3, or 5½, pr. 3 & 1½, pb. lg. 3½	Max. demand & flat rate	225,201	4.5	..	..	25 KW. motor alternator for charging batteries and taking day load. Data to 31 3 04	155
armd., dist. in	£175,973	124,896	38 arc, 48 inc. 4 Nernst.	139=429 H.P.	..	140,161	5	Lg. 4, pr. 2 & 1, pb. lg. £17½ & 338 p.a.	Flat rate & scale	1,587,874	3.85	.89	1.22	.. ..	156
sheathed; dist. ompton	£302,933	173,546	20 arc, 42 Nernst	419=2670 H.P.	..	240,512	10.36	Lg. 5 & 2, or 4½, pr. 2 to 1*	Max. demand fl. r. & scale	3,212,812	2.89	1.03	1.27	*Pb. lg. are. £22, Nernst £6 (1 ampere)	157
.. .. ..	£135,000	50,500	60 arc, 1,400 inc., 12 Nernst	47=301 H.P.	44=1,100 H.P.	90,852	..	Lg. 6 & 2, or 4½, pr. 3 to 1, tr. 1½*	Max. demand & flat rate	1,836,833	..	..	..	Lg. and tr. * Pb. lg. £18 & £4 ..	158
re., armd., direct	£6,000	1,900	36 inc. ..	4=15 H.P. ..	..	2,444	6	Lg. 6, pr. 3, htg. 1, pb. lg. 2.9	Flat rate and contract	17,500	4.78	3.08	..	.. ..	159
drs. triple conc.,	..	..	..	..	..	..	..	Lg. 7 & 3, or 6, pr. 4 & 1½, or 2½	Max. demand & flat rate	..	..	..	..	Part supply commenced May 1st, 1905	160
solid in wood ..	£79,824	29,150	..	102=291 H.P.	72=1,800 H.P.	88,280	75	Lg. 6 to 4, pr. 2 to 1½, tr. 1½	Flat rate with rebates	1,066,285	1,976	1.698	1.425	Lg. & tr. Data given for first full year of working	161
.. .. ..	..	..	..	..	..	..	..	.. ..	..	..	..	..	..	.. ..	162
allender	£26,145	4,252	..	32=272 H.P.	..	11,052	97	Lg. 5¾, pr. 1½	Flat rate ..	129,003	2.94	2.56	2.9	Pressure shortly to be altered to 240 & 480 volts	163
, single, solid ..	£50,000	8,000	14 arc, 24 inc., 44 Nernst	54=200 H.P.	16=592 ..	14,120	..	Lg. 7 & 3, or 5, pr. 2½ to 1½, pb. lg. 2½, tr. 2	Max. demand & flat rate	184,307	3.61	1.41	2.40	Lg. & Tr. Data to June 30, 1904 ..	164
.. .. ..	£12,751	4,708	..	..	..	4,787	47.1	Lg. 6, pr. 3	Flat rate	49,495	6.04*	3.5*	5.9*	* 1904	165
.. .. ..	..	..	..	..	..	..	..	Lg. 6	Flat rate ..	..	..	..	..	* Management in the hands of the Windermere Co.	166
.. .. ..	£27,550	6,479	30 arc, 61 inc., 1 Nernst	37=128 H.P.	..	11,129	..	Lg. 4½, arc £17, pr. 2 to 1½	Flat rate ..	118,928*	3.206	1.617	2.767	Station opened May 7th, 1904, and energy supplied free until 1st June, 1904. *10 months.	167
p. power cables, 3-	..	11,892	..	387 H.P. ..	680 H.P. ..	46,036	9	Lg. 7 & 2½, pr. 4½ & 1½ ..	Max. demand with dis.	511,427	..	1.31	1.77	Lg. and tr.	168
covd. conc. ..	..	3,200	3 inc. ..	..	..	..	..	Lg. 5	Contract & flat rate	..	..	..	..	.. ..	169
.. .. ..	£15,000	..	3 Nernst ..	2=3 H.P. ..	..	5,878	50	Lg. 6, pb. lg. 4, pr. 4 ..	Flat rate ..	16,917	5.9	..	..	.. ..	170
.. .. ..	..	..	..	..	..	..	..	Lg. 5 to 3, pr. 2¼ to 1½, tr. 1½	Sl. scale and flat rate	..	..	..	..	.. ..	171
conc.	£46,466	15,716	10 arc, 457 inc., 33 Nernst	44=189 H.P.	..	22,894	8.4	Lg. 5, 4½, 4½*, pb. lg. 2.15	Flat rate & max. demand	446,112	2.88	0.992	1.391	* Pr. 3 & 1¼, or 1½ & 1½ flat rate, restricted hours' use	172
armd. conc. laid	£92,205	31,841	75 arc, 124 inc., 9 Nernst	27=70.5 H.P.	..	35,087	18	Lg. 7 & 3, pr. 3 to 2, pb. lg. 3	Max. demand	527,133	4.7	1.609	2.095	.. ..	173
n wood	£57,094	12,016	104 arc, 208 inc.	250 H.P.	44=1232 H.P.	52,128	..	Lg. 4½, pr. 2½, pb. lg. £12 arc p.a., tr. 1½	Sliding scale	830,185	1.99	.856	1.111	Lg. and tr.	174
.. .. ..	£61,386	30,773	40 arc, 80 inc.	71=268 H.P.	20=500 H.P.	49,656	8.5	Lg. 5, pr. 2½, pb. lg. 1.44, tr. 2	Flat rate & scale	637,894	3.06	1.41	1.85	Small day load; costs high due to heavy stand-by losses	175
copper, overhead	..	2,000	3 Nernst, 125 inc.	..	..	..	..	Lg. from 1¼, pb. lg. £2.6 p. 16 c.p. p.a.	Contract & meters	..	..	..	..	.. ..	176
, dist. bit. solid..	..	16,679	1 arc.. ..	21=50 H.P.	..	17,929	4	Lg. 7 & 2½, or 6, pr. 4 to 2½	M. d., flat rate, & time switch*	169,313	..	..	..	* Time switch system, 2½d. for 20 hrs. and 6d. for 4 hrs. per day	177
loward troughing	£18,465 (abt.)	6,241	..	2=7 H.P. ..	..	6,393	53	Lg. 7 & 4*, pr. 4	Flat rate & sl. scale	43,118	5.9	3.7	5.4	* 7d. for first 14 units per 8-C.P. p.a. and 4d. after. 20% dis. to long hour cons.	178
.. .. ..	£822,123	260,670	247 arc ..	836=3,905 H.P.	..	362,248	17.7	Lg. 4 & 1, pb. lg. 1¼, pr. 2 to 1½	Special scale† & max. dem.	..	..	..	..	* Also 50~, 1-ph. † Lg., 4d. first 1,000 hrs. use of lamps, 1d. after; pr. m.d.	179
paper, bitite sh.; r. bit., solid	£11,861	2,555	..	9=18 H.P....	..	3,069	..	Lg. 7 & 3, or 6, pr. 2½ to 1½	Max. dem., flat rate & sl. scale	14,207	4.51	..	..	9½ months' working	180
.. .. ..	£245,131	152,152	..	188=704 H.P.	..	186,316	17	Lg. 4, pr. 2	Flat rate ..	1,940,014	3.79	0.89	1.47	.. ..	181
nchor Cable Co.,	..	14,115	..	123=829 H.P.	..	..	..	Ltg. 7 & 2½, or 5, pr. 3 & ⅞	Max. demand & flat rate	475,000	2.25	..	..	.. ..	182
with steel plates,	£125,000	51,323	288 arc ..	234=1,788 H.P.	..	105,799	27.95	Lg. 3¾, pb. lg. £18, pr. 1½	Flat rate with discount	..	..	..	..	Tramway under construction. 3,000 KW. extension in hand	183
onc., dist. 3-core	£25,044	6,245	..	5=18½ H.P.	..	6,930	17	Lg. 7 & 2½, or 6, pr. 4½ & 1½, or 2½	Max. demand & flat rate	85,130	4.58	2.69	4.09	.. ..	184
or dist.	£147,000	52,425	1080 arc, 3,305 inc.	28=119 H.P.	..	59,953	16	Lg. 5 & 2, pr. 3 & 1 or 2*	Max. demand & flat rate	1,357,254	3.375	1.247	1.607	*Pb. lg. £21 per arc & £4.175 inc. (two 40-c.p. lamps)	185
.. .. ..	..	1,000	..	..	..	..	..	10s. per 8-C.P.	Contract ..	..	..	..	..	.. ..	86
.. .. ..	..	..	..	..	..	..	..	Lg. 5, pr. 2	Flat rate ..	..	..	..	..	.. ..	
conc. and triple	£35,550	29,849	34 arc, 60 inc., 34 Nernst	67=122 H.P.	..	33,606	18.4	Lg. 6 & 2½, pr. 4 & 1, or 2½*	Max. dem. w. dis.. & flat r.	431,473	3.7	1.088	1.598	*Special rates to large consumers ..	188
.. .. ..	£1,718,712	476,584	189 arc 28 inc.	1,369=5,193 H.P.	..	583,430 (ex. tr.)	11	Lg. 3¾ & 3, pr. 2 & 1, pb. lg. 2, tr. 1.07†	Sliding scale & flat rate	29,333,623	1.879	.572	.816	*Lg. & tr., large traction load. †Plus 5% for every 1s. paid for coal above 6s. ton	189
lid	£49,093	32,808	16 inc., 160 Nernst.	3=2½ H.P....	..	33,034	..	Lg. 5, or 9 & 1½, pr. 2½, pb. lg. 5, less 33½%	Flat rate and max. dem.	246,943	4.72	1.67	2.87	* Gt. Crosby and Waterloo	190

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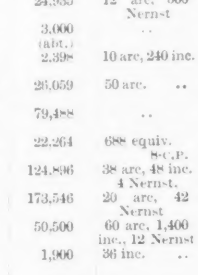

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